Specifications For:

City of Thorne Bay, Alaska

Water Treatment Plant Improvements

November 2018

Volume 1 of 1

Divisions 1-46

Prepared For:

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Approved for Construction

DIVISION 01: GENERAL REQUIREMENTS
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23 00 00: Heating, Ventilating, and Air Conditioning

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SECTION 01 10 00 – SUMMARY OF WORK

PART 1 -- GENERAL

1.1 SCOPE

A. The scope of this section includes general project description, site access, coordination and various project details.

B. RELATED SECTIONS

1. Section 017500 Startup and Commissioning

1.2 PROJECT INFORMATION

A. General

1. Project includes modifications and upgrades to the existing water treatment plant, replacement of the existing building roofing system, addition of a new room on the back of the existing building, installation of a new nano-filtration (NF) membrane skid system, and other minor items required to complete the water treatment plant site expansion all located on the existing site. The project also includes significant electrical and system controls upgrades.

B. Owner-procured Equipment and Services

1. The Owner has purchased equipment through a competitive proposal process. The respective equipment suppliers are under contract with the City to supply and commission the equipment.

a. The full, approved equipment submittals will be included as attachments to the contract documents for Contractor's reference and use in installing the equipment.

b. The division of work and supply is generally delineated in the Construction Drawings but the full scope of supply is provided in the respective, approved submittal documents.

c. It is the Contractor's responsibility to understand the scope of equipment supply and account for installation, testing and commissioning of the equipment in accordance with approved submittal documents included as part of these contract documents.

d. The contract with the manufacturers for supply of the equipment will remain with the City. No contract will be assumed by Contractor.

e. The Contractor will assume full responsibility for receiving the equipment, moving the equipment from the receiving dock to the site, installation in accordance with the manufacturer's instructions, and coordinating startup assistance, testing, and operator training with the manufacturer.

f. The Owner procured equipment delivery date will be established prior to issuing the Contractor's "Notice to Proceed".

g. In the event of equipment delivery delay beyond the established time frames, Contractor shall make no claim for delay for a delivery delay up to and including 30 days.

h. All payment to the NF manufacturer and Systems Integrator will be by the Owner.

2. Nano-filtration (NF) Membrane filter:

a. The City has purchased the NF membrane filter. Vendor is under contract to supply the NF equipment and controls identified in Specification 46 07 13.

b. For reference to installation instructions and pre-startup checklists CONTRACTOR shall refer to the equipment submittals included by appendix in the Contract Documents. If additional information is required, questions shall be directed to the ENGINEER.

3. Systems Integrator:

a. The Owner has independently contracted for the services of a Systems Integrator (SI). CONTRACTOR shall refer to the Systems Integrator specifications for a detailed SCOPE OF WORK. The basic Systems Integrator Scope of Work is generalized as:

i. Furnish a programmable logic controller (PLC) based Water Treatment Control Panel, (WTCP) with remote SCADA capabilities complete and operable, in accordance with specification section 40 95 13 – Control Panels and the Contract Documents. Drawings pertinent to this scope of work include Sheets E13 and IC01- IC09.
ii. The intent is for the SI to furnish the WTCP to be installed and wired by an installation CONTRACTOR in the field. The SI shall verify with the CONTRACTOR's site electrician the proper wiring terminations and provide field testing and start-up services.
iii. Provide all programming, testing and training of the WTCP as shown on the drawings and as required herein.
iv. Coordinate with all parties including the CONTRACTOR, Systems Integrator, Nano-Filtration System Supplier, local utilities, mechanical and electrical subcontractors, ENGINEER and OWNER to ensure a complete and functional water treatment plant in accordance with the Contract Documents.

1.3 PROJECT DESCRIPTION

A. Water Plant Building Modifications: The existing treatment plant building will be modified to accommodate improvements to the treatment process. The building modifications include but are not limited to the following:

1. Demolition of existing roof structure, and portions of the existing walls.

2. Building foundation expansion and subsurface improvements.

3. Construct building addition walls and roof.

4. Mechanical and electrical improvements to the building, including:

   a. Re-installation of generator and improvements to HVAC and lighting systems.

   b. Installation of new electrical service, electrical overload protection panels, and transformers.

5. Building finish construction including new building siding and civil site improvements.

B. Install the Water Treatment Control Panel (WTCP) and associated treatment plant equipment including the following:

1. Install and wire the WTCP, provided by Others.

2. Install process equipment and power, including:

   a. Back wash pump.

   b. Re-circulation pumps.

   c. Chemical feed pumps.

3. Install water quality monitoring equipment.

4. Install air blower and air piping.

5. Coordinate with System Integrator to integrate the WTCP with the filter operation and automation.

C. Install Owner Procured NF Membrane filter, including the following:

1. The installation of piping and valving on the existing filtered water line to direct the filtered water into the NF system for further treatment and a bypass line/valve for use in emergency or maintenance situations. The valving installation will require a temporary shutdown of the treatment facility's discharge. The temporary shutdown shall be closely coordinated with the Owner to ensure no interruption of potable water delivery is experienced by the City. Minimum water level/volume for firefighting activities shall be maintained in the existing potable water storage tanks at all times.

2. The Contractor shall install the City purchased NF membrane filter, electrical components and controls per the NF manufacturer installation instructions. The Contractor shall coordinate the system startup, commissioning, and training with both the Owner, System Integrator, and the equipment manufacturer.

1.4 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of project site beyond areas in which the Work is indicated.

1.5 SURFACE AND SUBSURFACE CONDITIONS

A. The CONTRACTOR shall satisfy himself as to the surface, subsurface, and ground water conditions at the site of the work.

1.6 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.

2. Provide not less than 72 hours notice to Owner of activities that will affect Owner's operations.

B. Use of Premises.

1. The CONTRACTOR shall confine his operations to existing rights of way, easements, and designated construction corridors at the site of the proposed work.

2. The CONTRACTOR shall familiarize itself with the site and ensure all activities and storage of materials do not occur within 10 feet of steep upward and downward sloped areas located on three sides of the site.

C. Security

1. CONTRACTOR shall be responsible for the security of all materials, equipment, tools, etc. used on the job. All materials which can be easily removed shall be stored in a locked building provided by the CONTRACTOR. All material inventoried and in storage which have been paid for on monthly progress payments must be in Owner’s possession and stored on-site or at a secure location acceptable to the OWNER and ENGINEER.

1.7 EXISTING FACILITIES

A. Existing Treatment Facility

1. The WORK will be executed while the existing water treatment facility is in operation. Operation of the existing treatment facility/process shall not be jeopardized nor shall the capacity or efficiency of treatment be reduced as a result of the execution of the WORK, unless specifically stated.

2. The CONTRACTOR shall take necessary precautions to ensure that no damage occurs to the plant facilities, including piping, utilities, roads, building, and structures, that are to remain in operation and are not to be modified or replaced. Any temporary facilities, materials, equipment, and labor required for the plant to continue to operation during construction shall be provided by the CONTRACTOR as part of the WORK. At

the completion of work, such temporary facilities, materials, and equipment shall be removed from the Site as part of the WORK.

3. Unless indicated otherwise, temporary pumping, piping, power, lighting, controls, instrumentation, alarms, security devices, and safety devices shall be provided by the CONTRACTOR whenever its activity or interruption due to its activity affects the existing facility.

B. Protection of Existing Utilities

1. Existing underground installations such as water mains, gas mains, sewers lines, stormwater mains, telephone lines, power lines, and buried structures in the vicinity of the work to be done hereunder are indicated on the drawings only to the extent such information has been made available to or discovered by the ENGINEER in preparing the drawings. There is no guarantee as to the accuracy or completeness of such information, and all responsibility for the accuracy and completeness thereof is expressly disclaimed.

2. Utility service connections are generally shown on the Drawings, but the CONTRACTOR shall be solely responsible for locating all existing underground installations, including service connections, in advance of excavating or trenching, by contacting the owners thereof and prospecting. The CONTRACTOR shall use his own information and shall not rely solely upon information shown on the drawings concerning existing underground installations. The CONTRACTOR shall protect utilities during excavation and repair all damage to existing utilities or property to the satisfaction of the utility owner or property owner at his own expense.

3. If any existing underground utility or facility not shown on the drawings is located so that it interferes with the work and has to be moved or otherwise modified, such work shall be done by the CONTRACTOR, and adjustment in payment will be made according to the GENERAL CONDITIONS. Except as stated above, any delay, additional work or extra cost to the CONTRACTOR caused by existing underground installation shall not constitute a claim for extra work, additional payment, or damages.

4. Temporary service shall be provided by the CONTRACTOR during any period when utility lines are disturbed unless the CONTRACTOR makes other arrangements with the utility users and of existing utility lines, if interrupted, shall be restored as quickly as possible. Do not interrupt existing utility services without written permission from ENGINEER.

5. The CONTRACTOR shall coordinate with the utility companies for the protection or adjustment of existing utilities in the vicinity of the work and shall have utility company representatives present when necessary to support utility poles or buried utility lines while working adjacent to such utilities. The CONTRACTOR shall pay all costs associated with having utility company representatives on the site for this work and shall include these costs in the price bid for related items of work. Utility contact numbers include but may not be limited to the following:

   a. Power and Telephone: Alaska Power and Telephone, Inc.

1.8 PROTECTION OF EXISTING STRUCTURES

A. Where construction will be required adjacent to existing structures, the CONTRACTOR shall be solely responsible to maintain the structural integrity of the existing structures. The CONTRACTOR shall take whatever means necessary to ensure that the existing structure is not damaged and, if necessary, shall install shoring or sheet piling or change the size or type of construction equipment. The CONTRACTOR shall repair all damage to the existing structures at his own expense. Any fences destroyed during construction shall be repaired to the satisfaction of the OWNER. Any delay, additional work, or extra cost to the CONTRACTOR caused by existing underground installations shall not constitute a claim for extra work, additional payment or damages. Unless otherwise noted on the Construction Drawings, all existing ditches disturbed by construction shall be restored to their original size, line, and grade.

B. Field Check of Existing Structures

1. The dimensions and elevations of existing structures and locations of existing fences, pipelines, conduits, cables, and equipment shown on the drawings were taken for the most part from available records and survey data and are not guaranteed for accuracy.

2. It shall be the responsibility of the CONTRACTOR to check all dimensions and elevations of existing structures, pipelines, conduits, cables, equipment, or other existing items, both above and below ground, affected by or affecting the Work under this contract, prior to the start of construction or ordering materials and equipment affected thereby.

3. The CONTRACTOR's attention is directed to the Instructions to Bidders which recommends that each bidder visit the site of the Work to familiarize himself with the arrangement and condition of existing construction that is to be connected to or that is to remain in place.

1.9 TEMPORARY CONNECTIONS

A. Making connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be thoroughly planned in advance, and required equipment, materials, and labor shall be on hand at the time of undertaking the connections. WORK shall be completed as quickly as possible and with as little delay as possible and shall proceed continuously (24 hours a day and seven days a week) if necessary to complete modifications and/or connections in the minimum time.

B. The cost of any temporary facilities shall be included in the WORK.

C. Temporary facilities and piping shall be located to minimize interference with CONTRACTOR's construction facilities and OWNER's operation and maintenance of the water treatment plant. Unless otherwise indicated, each temporary pipeline shall be of the same size as its connection to the existing or permanent facility at the downstream end of the pipeline. Piping materials shall be suitable for the material being conveyed and be as required in the Contract Specifications.

1.10 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work at the project site to normal business working hours of 7 a.m. to 6 p.m., Monday through Friday, unless otherwise indicated and/or approved.

1. Weekend Hours: Upon approval of Owner.

1.11 EXISTING UTILITY INTERRUPTIONS:

A. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

B. Notify Owner and Engineer not less than two days in advance of proposed utility interruptions.

C. Obtain Owner's and Engineer's written permission before proceeding with utility interruptions.

1.12 ENVIRONMENTAL CONTROLS

A. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

B. Nonsmoking Building: Smoking is not permitted within the new buildings or within 25 feet of entrances, operable windows, or outdoor-air intakes.

C. Keep project neat, orderly, and in a safe condition at all times.

D. The CONTRACTOR shall sweep paved areas and water unpaved dry areas as deemed necessary by the ENGINEER to control soil and dust.

E. CONTRACTOR shall dispose of all oil and petroleum products in an appropriate manner off-site. This requirement shall include any and all materials used for clean-up of such materials.

F. Working Hours and Noise Restriction. To minimize construction noise impacts on the local residents, no construction activities will be allowed between the hours of 6:00 p.m. and 7:00 a.m., unless explicitly allowed by the ENGINEER in writing.

G. Adverse Weather Conditions. Should adverse weather require a shutdown of the work by the OWNER or the CONTRACTOR, CONTRACTOR shall be responsible for any and all costs associated with the shutdown including but not limited to periodic road maintenance during shutdown period, demobilization, remobilization, and lost overhead and profit to the CONTRACTOR and any subcontractors.

1.13 TEMPORARY CONTROLS

A. General. Temporary service shall be provided by the CONTRACTOR during any period when utility lines are disturbed unless the CONTRACTOR makes other arrangements

with the utility users and owners that are satisfactory to said users and owners. Service of existing utility lines, if interrupted, shall be restored as quickly as possible.

1.14 RECORD DRAWINGS

A. General The CONTRACTOR's superintendent or his designated representative shall maintain, at the project site, a "Record Set of Drawings" showing field changes, as built elevations, unusual conditions and utilities encountered during construction, dimensions to exposed features both for depth below finished grade and horizontal distance from a permanent surface feature, manufacturer's catalog number of equipment supplied, and other data as required to provide the OWNER with an accurate "as constructed" set of Drawings. Record drawings shall be maintained on a full size plan set in a neat and legible condition. Drawing set shall not be used for construction purposes and shall be available for review by the Resident Project Representative at the job site during normal working hours.

1. Markings: Use red erasable colored pencils to annotate record drawings.

2. Review for Progress Payments. Prior to approval of each successive Progress Payment, CONTRACTOR will be asked to update and present the record drawing set to the ENGINEER or ENGINEER’s field representative prior to ENGINEER approving the pay request. An approval by the ENGINEER shall not be given on the final payment request until complete record drawings are submitted to the ENGINEER. Final record drawings from the CONTRACTOR shall be submitted at least 7 days before the final progress payment to allow time to review the drawing for completeness. Failure to submit record drawings in a timely manner, as described, may delay approval of final progress payment.

PART 2 -- PRODUCTS

2.1 NOT USED

PART 3 -- EXECUTION

3.1 NOT USED

- END OF SECTION -

SECTION 01 20 00 – PRICE AND PAYMENT PROCEDURES

PART 1 -- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Special Provisions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

B. The total bid price for each item of the contract shall cover all work shown on the contract drawings and required by the specifications and other Contract Documents. All costs in connection with the work, including furnishing all materials, equipment, supplies and appurtenances; providing all construction plant, equipment, and tools; and performing all necessary labor and supervision to fully complete the Work, shall be included in the unit and lump sum prices bid. No item that is required by the Contract Documents for the proper and successful completion of the Work will be paid for outside of or in addition to the prices submitted in the bid. All work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of the CONTRACTOR and all costs in connection therewith shall be included in the prices bid.

1.4 ESTIMATED QUANTITIES

A. All estimated quantities for unit price items to be paid per field measurement as stipulated in the Bid Form or other Contract Documents are approximate and are to be used only (a) as a basis for estimating the probable cost of the Work and (b) for the purpose of comparing the bids submitted for the Work. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished and accepted. The CONTRACTOR agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amount of work actually performed and materials actually furnished and the estimated amounts herein except as follows.

B. Either the OWNER or the CONTRACTOR may demand in writing that a supplemental agreement or change order be prepared to authorize an adjustment in the unit price of any MAJOR CONTRACT item if the quantity of said MAJOR CONTRACT item increases or decreases by more than 25 percent from that shown in the Contract Documents. A MAJOR CONTRACT item is defined as any item having an original contract value in excess of 10 percent of the total original contract.

C. If one of the bid items described in Article 1.9 of this section is not included in a particular schedule or zone on the Bid Form but measurement and payment for that item is required according to the drawings and/or by the ENGINEER, the unit price from a similar schedule or zone will be used to establish the unit price for that item in the other schedule or zone.

1.5 AUTHORITY

A. The ENGINEER will perform all measurements and compute quantities for payment. The ENGINEER will verify measurements and quantities provided by the CONTRACTOR. The CONTRACTOR shall provide ENGINEER access to work areas for survey measurements, as required.

1.6 NON-PAYMENT ITEMS

A. Separate or specific payment will not be made for certain items, including but not limited to:

1. Wasted products.

2. Products that are wasted, disposed of, or otherwise handled in an unacceptable manner.

3. Products determined to be unacceptable in the opinion of the ENGINEER, before or after placement.

4. Products not completely unloaded from the transporting vehicle.

5. Products placed beyond the lines and grades of the required work.

6. Products remaining on hand after completion of the work.

7. Loading, hauling, and disposing of rejected products.

8. Concrete that is delivered without a batch ticket or with a ticket that does not show actual batch weights, aggregate absorption, and aggregate-moisture content.

9. Overly wet, overly dry, or frozen-earth material.

10. Excavation or fill made for the convenience of the CONTRACTOR.

11. Over excavation and backfill of over excavation.

12. Work performed that has been rejected and/or determined to be defective.

1.7 MEASURED QUANTITIES

A. Measurement by Volume: Measured by cubic dimension using mean length, width, and height or thickness.

B. Measurement for payment of excavations upon or against which concrete is not to be placed will be limited to the lines and grades shown on the Drawings or to the most

practical lines, grades, and dimensions established by the ENGINEER, in writing. No measurement will be made of over excavations beyond design lines and grades.

C. No measurement for payment will be made for additional concrete that results from subgrade surface irregularities. Such additional concrete is considered incidental and therefore included in the Contract price for the applicable item.

D. Fill quantities will be computed using the average-end-area method or other computation method approved of by the ENGINEER.

E. Measurement by Area: Measured by square dimension using mean length and width or radius. Items that are measured by area will be measured parallel to the ground surface.

F. Linear Measurement: Measured by linear dimension at the item centerline or mean chord. Items that are measured by the lineal foot, such as pipe, will be measured parallel to the ground surface, unless otherwise specified.

G. Stipulated Sum/Price Items: Measured by weight, volume, area, or linear means, or combination, as appropriate, as completed items or units of the work.

H. Lump-Sum Items: Will not be measured for payment. However, measurements may be made to monitor work progress.

1.8 SCHEDULE OF VALUES

A. A schedule of values or “allocation of contract price” is required for major lump sum items. The schedule of values is used only to help assess the intermediate value of work completed for the purpose of making progress payments.

1. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

2. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

3. The schedule of values is included as Attachment A to this specification.

1.9 MEASUREMENT AND PAYMENT ITEMS

B. Measurement: Shall be by percent or work completed for Lump Sum Items or by unit price as specified in the Schedule of Values.

C. Payment: Payment for this item shall be made based on percent of work completed compared to the Contractor-furnished and Engineer approved Schedule of Values.

PART 1 - PRODUCTS (Not Used)

PART 2 - EXECUTION (Not Used)

- END OF SECTION -

Schedule of Values

Item	Description	units	quantity	Unit Price	Total
Schedule A	Water Plant Building and Power Supply Upgrades		Schdule A1 through A8 Subtotal =		
A1.0	General Conditions			A1 Subtotal =	
A1.1	Superintendent	ea	1		
A1.2	Housing and travel	ls	1		
A1.3	Material Procurement*	ls	Included in the itemized costs		
A1.4	Equipment mobilization*	ls	1		
A1.5	Engineering and Quality Control*	ea	1		
A1.6	Safety planning and equipment*	ea	1		

*present an itemized list.

A2.0	Building Demolition			A2 Subtotal =	
A2.1	remove building siding and trim, and associated equipment	sf	1396		
A2.2	remove roofing and roof structure	sf	1938		
A2.3	remove columns and footing bases along outside northwest wall	ea	7		
A2.4	remove and temporarily house the generator.	ls	1		
A2.5	demolish the generator walls and mechanical equipment	lf	29		
A2.6	remove sections of existing northwest wall for wall columns and doors.	ea	4		
A2.7	dispose of demolition waste.	tons	13		

Schedule of Values

Item	Description	units	quantity	Unit Price	Total
A3.0	Building Addition Foundation			A3 Subtotal =	
A3.1	overexcavate building addition footprint area	cy	27		
A3.2	Install drain piping around northwest and northeast ends of building, and under slab area. Bed pipe with NFS material per the specifications.	lf	106		
A3.3	Install raw water pump feeder, area light, and the KRBD Radio Repeater (notes 6, 8, and 10 on sheet E02.)	lf	140		
A3.4	Lay and compact subgrade, 3/4-inch minus material, 1-foot depth	sf	740		
A3.5	form and place reinforcement steel in slab and thickened slab foundation. (12 in x 12 in, 36 in x 36 in, 24 in x 24 in)	sf	576		
A3.6	Pour and finish slab and foundation	cy	28.4		
A3.7	Inspection by Engineer (by others)				
A4.0	Building Addition Walls and Roof			A4 Subtotal =	
A4.1	Erect roof columns in the existing northwest wall	ea	2		
A4.2	exterior wall: frame, insulate, and apply vapor and air retarder (quantity is frame sf)	sf	700		
A4.3	interior wall: frame, insulate, and apply vapor and air retarder (quantity is the frame quantity for partition and center wall).	sf	610		
A4.4	Erect portal frame (anchor and frame W6x16)	lbs	614		
A4.5	frame the new roof (include glulam beam)	sf	2058		
A4.6	finish the interior walls	sf	2620		
A4.7	finish the new roof	sf	2058		
A4.8	finish exterior walls	sf	700		

Schedule of Values

Item	Description	units	quantity	Unit Price	Total
A4.9	Install the overhead door to the new building addition and finish	ea	1		
A4.10	Install interior doors and hardware	ea	3		
A4.11	Install exterior doors and hardware	ea	1		
A4.12	Inspection by Engineer (by others)				
A5.0	Mechanical, Building			A5 Subtotal =	
A5.1	Install chemical room ventilation, fans and venting	ea	2		
A5.2	Install building addition Toyo Stove and fuel lines	ea	2		
A5.3	Install generator, and generator battery charger	ea	1		
A5.4	Install gravity louver, air control dampers (and associated actuators).	ls	1		
A5.5	Install fuel supply and storage. (reuse existing tank)	ls	1		
A5.6	Inspect and test the generator, fan, and heater installation and function by others				
A6.0	Electrical Service Replacement			A6 Subtotal =	
A6.1	Demolish existing electrical service	ls	1		
A6.2	Develop plan to maintain service during electrical change over and execute it.	ls	1		
A6.3	Install service drop, disconnect and meter base	ls	1		
A6.4	Relocate MDP, and install Panel A and the transformer (item 5 on the sheet E08 equipment sechedule).	ls	1		
A6.5	Mount the WTCP (equipment provided by others). Wire to Panel A. Wire to ethernet. (E13)	ls	1		

Schedule of Values

Item	Description	units	quantity	Unit Price	Total
A6.6	Wire equipment including starter/disconnect to MDP and WTCP (sheet E10): Air Pump (B-200), Backwash Pump (P-410)	ls	1		
A6.7	Connect new lake service line to the relocated MDP.	ls	1		
A6.8	Wire equipment (and any associated starter/disconnects) to Panel A and WTCP: Re-circ pump (P-410), domestic water pump (DWP-1), Exhaust fans (EF-1, EF-2, and EF-3), and unit heaters.	ls	1		
A6.9	Wire chemical feed pumps and chemical feed outlets to Panel A and WTCP (Sheet E11): Polymer pump (CF-100), Chlorine feed pump (CF-500), Soda Ash Pump (CF-501)	ls	1		
A6.10	Wire lights and fixtures per sheet E05. Wire receptacles per sheet E04.	ls	1		
A6.11	Wire existing instruments to Panel A and WTCP: turbidimeters, flow meters.	ls	1		
A6.12	Inspect and test equipment and instrument operational function by engineer (by others)				
A7.0	Automate the filters			A7 Subtotal =	
A7.1	Confirm the existing Bray valve viability				
A7.2	Install air blower and plumb the air piping for air scour	ls	1		
A7.3	Mount and wire the air and water valve motors and test the motor function -- closing, closed, opening, and opened.	ls	1		
A7.4	Inspection and testing of wiring.	ls	1		
A7.5	Start up by others (WTCP integrator). Contractor, including electrical and mechancial to be on site for inspection and assist with start up.				
A7.6	Training by others				
A8.0	Nanofiltration Equipment			A8 Subtotal =	

Schedule of Values

Item	Description	units	quantity	Unit Price	Total
A8.1	Plumb the NF unit, supply, return, and waste piping.	ls	1		
A8.2	Install and plumb the nanofiltration unit and equipment (owner provided, manufactured by Pure Aqua).	ls	1		
A8.3	Wire the nanofiltration control panel. Provide all field wiring connections (power and control) to the nanofiltration control panel and equipment.	ls	1		
A8.4	Inspect and test plumbing and electrical associated with nanofiltration equipment and instruments.	ls	1		
A8.5	Start up the nanofiltration unit. Requires Pure Aqua start up representative, Engineer, and the System Integrator (owner furnished)	ls	1		
A8.6	Inspect and test equipment and instrument operational function by engineer and Pure Aqua (by others)				
A8.7	Training by others				
A9.0	Self Back-washing Screen			A9 Subtotal =	
A9.1	Install Self Back-washing equipment* (BS-1). Requires equipment submittal.	ls	1		
A9.2	Wire the Self Back-washing Screen (BS-1) to Panel A and WTCP.	ls	1		
A9.3	Inspection by Engineer (by others				

* includes contractor procured equipment.

Note that cost score will be based on the Total value.

Total Schedule A =

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

A. Shop Drawings: All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for CONTRACTOR to illustrate some portion of the work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams, and other information prepared by a supplier and submitted by CONTRACTOR to illustrate material or equipment for some portion of the work.

B. Sample: Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the work will be judged.

C. CONTRACTOR's Review and Approval: Article 7.16 of the Standard General Conditions (EJCDC No. C-700) identifies the CONTRACTOR's obligations in respect to the submittal, review, and approval of Shop Drawings and Samples. CONTRACTOR shall satisfy CONTRACTOR's obligations with respect to review and approval per the Standard General Conditions and the requirements of this section (013300).

D. ENGINEER's Review and Approval: Article 7.16.D of the Standard General Conditions (EJCDC No. C-700) identifies the ENGINEER's obligations in respect to review and approval of shop drawings and samples. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed project as a functioning whole as indicated by the Contract Documents.

PART 2 - PRODUCTS

None

PART 3 - EXECUTION

3.1 SUBMITTAL PROCEDURE:

A. Shop Drawings shall be submitted as specified in Article 7.16 of the Standard General Conditions. In addition, Shop Drawings, Progress Pay Estimates, Closeout Documents, and all other project submittals shall be submitted as follows:

1. ENGINEER will establish an electronic submittal registry for this project through Submittal Exchange (http://www.submittalexchange.com/public/), or NewForma Info Exchange. These are electronic submittal registry programs.

2. In accordance with Article 2.03.A.2 and 2.05.A.2 of the Standard General Conditions, CONTRACTOR shall submit and receive approval of a schedule of shop drawings and sample submittals which will list each required submittal and the times for submitting, reviewing and processing such submittal.

3. Date and Number: At least 30 days prior to CONTRACTOR's need for approval, CONTRACTOR shall electronically submit for approval, the requisite shop drawings and sample submittals. Paper copies will not be accepted. As part of the ENGINEER's account with Submittal Exchange, CONTRACTOR, Subcontractors and vendors will be provided access to Submittal Exchange free of charge throughout the duration of the project. In addition, ENGINEER has secured and paid for training sessions with CONTRACTOR and his team for use of Submittal Exchange.

4. In general, CONTRACTOR will upload the submittals to a pre-established portal identifying the project and the portion of the project to which it applies. All appropriate information shall be filled out and a listing of all variances from the contract documents shall be included.

5. Transmittal Form: All submittals shall be forwarded with a signed copy of the "TRANSMITTAL OF SHOP DRAWINGS" form attached at the end of this section, or similar, identifying the project and the portion of the project to which it applies. All appropriate information included on the transmittal form shall be filled out and a listing of all variances from the contract documents shall be included. Each transmittal form shall be signed by an individual authorized to do so, as a certification that the CONTRACTOR's responsibilities with respect to review and submission of the shop drawings have been satisfied.

6. Submittals that are related to or affect each other shall be forwarded simultaneously as a package to facilitate a coordinated review. Uncoordinated submittals will be rejected.

7. Submittal Exchange will log and coordinate the uploaded information in a pre-established submittal registry. E-mail notifications are then forwarded to the ENGINEER and the respective responsible reviewers. Each reviewer will be responsible for checking out the submittal, reviewing electronically and providing response as required. The reviewer then will re-post the reviewed package with appropriate notation and action to be taken. E-mail notifications are then forwarded to the CONTRACTOR regarding status of the submittal. All electronic file uploads will be in pdf format.

B. CONTRACTOR's Stamp:

1. All Shop Drawings and Samples are required to be submitted by the General Contractor and they shall bear a stamp or specific written indication directly on the submittal that confirms that the CONTRACTOR has satisfied all CONTRACTOR's responsibilities under the Contract Documents. ENGINEER will not accept shop drawings from anyone outside of the Prime Contractor or shop drawings that do not contain a stamp or other written indication on them that states that the CONTRACTOR has satisfied his responsibilities per the Contract Documents.

2. The ENGINEER's review and approval shall not relieve the CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each variation at the time of submission and ENGINEER has given written approval.

C. ENGINEER'S APPROVAL:

1. The ENGINEER will indicate his approval or disapproval of each submittal and, if he does not approve the submittal as submitted, will indicate his reasons therefor. Any work done prior to approval shall be at the CONTRACTOR's own risk. Approvals shall not relieve the CONTRACTOR from responsibility for complying with the requirements of this Contract. If submittals show variations from the Contract requirements, the CONTRACTOR shall describe such variations in writing, within the before mentioned cover letter at the time of submission. Approval of such variation(s) shall be accompanied with a Contract Modification. Minor variations not involving a change in price or time of performance will not be issued a modification.

D. REQUIRED SUBMITTALS:

1. Permits: Submit to the ENGINEER at the preconstruction conference a copy of all permits required by the governing authorities.

2. Subcontractors: At the Preconstruction Conference, the CONTRACTOR shall supply a list of all suppliers and subcontractors to be used on the project.

3. Equipment List and Rental Rates: At the preconstruction conference, the CONTRACTOR shall supply a list of all equipment owned or rented that will be used on this project. The equipment list shall include the make, model, year, horsepower and capacity of each piece of equipment. The list shall also include rental rates and operating rates for each piece of equipment determined per the requirements of these contract documents.

4. Certificates: For those items called for in individual sections, furnish certificates from manufacturers, suppliers, or others certifying that materials or equipment

being furnished under the Contract comply with the requirements of these specifications.

5. Shop Drawings: See the individual sections for specific requirements.

6. Progress Schedule and Schedule of Values: The CONTRACTOR shall submit to the OWNER with the completed Agreement a Progress Schedule, Schedule of Values, and an estimated Progress Payment Schedule. The Progress Schedule shall be in bar chart or Critical Path Method (CPM) form and show estimated starting and completion dates for each part of the Work. The Progress Payment Schedule shall show the monthly progress payment requests that are estimated to be made through the duration of the Contract. Both the Progress Schedule and Payment Schedule shall be revised monthly to show project progress revisions to the schedules. The revised schedules shall be submitted with the monthly progress payment request. No monthly progress payment request shall be accepted from the CONTRACTOR and processed for payment unless accompanied by the revised schedules.

7. Operation and Maintenance Instructions: Manufacturer's printed instructions shall include installation instructions, operating instructions, maintenance literature, lubrication requirements, and parts lists.

8. Quality Control Plan: The CONTRACTOR shall submit his Quality Control Plan defining the program and documentation proposed ensure that all materials and work conform to the Contract Documents. The plan shall identify personnel, procedures, control, tests, frequency of tests, and records and forms to be used. The CONTRACTOR shall not commence work on any items requiring quality control until his plan is reviewed by the ENGINEER, and all deficiencies in the plan noted by ENGINEER have been corrected.

- END OF SECTION -

SUBMITTAL REVIEW TRANSMITTAL

Project Name: Thorne Bay Water Treatment Plant Improvements		**Submittal No._____** (Spec Section)-(Series)
Project Owner: City of Thorne Bay		**Date Received:**
Contractor:	**Engineer: DOWL**	**Engineer Project No.**
Address:	**Address:**	**Specification Section:**
Attn:	**Attn:**	**1st Submittal:**
Transmittal Date:	**Previous Transmittal Date:**	**Re-Submittal:**

DOWL SUBMITTAL REVIEW

ENGINEER'S review and approval of this submittal are expressly limited as provided in the Contract Documents and are only to determine conformance with information given in Contract Documents and compatibility with design concept of completed project as a functioning whole as indicated in the Contract Documents. CONTRACTOR is, and ENGINEER is NOT responsible for all matters relating to fabrication, shipping, handling, storage, assembly, installation, construction (including all safety aspects of performing the Work), and for coordinating the Work.

Item #	Description	Manufacturer/Vendor	Action

Action Legend

ANEN – Approved, No Exceptions Noted
AN – Approved as Noted
RR – Revise and Resubmit
R - Rejected
I/O - Informational

Remarks/Comments:

Reviewed By: _ **Review Date: ___**

SECTION 01 45 00 - QUALITY CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION:

This section describes the CONTRACTOR's "Quality Control" requirements and OWNER's "Quality Assurance" program.

1.2 DEFINITIONS:

A. Quality Control: Planned and specific actions or operations necessary to produce a product that complies with the Contract Documents. Quality Control consists of actions, inspections, sampling and testing necessary to ensure the Work is in compliance with the Contract Documents and to control production and construction processes. Quality Control is keyed to the construction sequence to quickly determine when the Work is out of compliance with the Contract Documents and to respond to correct the situation and bring the Work into compliance. Quality Control is the responsibility of the CONTRACTOR.

B. Quality Assurance: Planned and systematic observations, testing and actions to verify that the Work complies with the Contract Documents. Quality Assurance includes oversight of the CONTRACTOR's Quality Control, verifying the results of the CONTRACTOR's testing and additional assurance sampling and testing. Quality Assurance may not be adequate for the CONTRACTOR's production and placement needs. The OWNER or ENGINEER will provide Quality Assurance.

C. Verification/Compliance Testing: Sampling and testing which is carried out independent of the CONTRACTOR's Quality Control testing to confirm/verify that the Work complies with the Contract Documents. The frequency of verification/compliance testing will be determined by the OWNER and may not be adequate for the CONTRACTOR's production and placement needs. Verification/compliance testing will not be used to determine construction procedures or operations (i.e. rolling patterns, lift thickness, etc.). Verification/compliance testing will be provided by the OWNER and /or ENGINEER.

1.3 SUBMITTALS:

A. Quality Control Plan: At the preconstruction conference, the CONTRACTOR shall submit a Quality Control Plan defining the program and the documentation proposed to ensure that all materials and work conform to the Contract Documents. The plan shall identify personnel, procedures, control, tests, frequency of tests, and records and forms to be used.

B. Test Records: CONTRACTOR shall submit records of all tests to the ENGINEER within 24 hours of the testing. The Quality Control laboratory shall notify the CONTRACTOR and ENGINEER promptly of irregularities or deficiencies observed in the Work during performance of the Quality Control Testing.

PART 2 - PRODUCTS

NONE

PART 3 - EXECUTION

3.1 GENERAL:

A. Coordination: CONTRACTOR shall be responsible for Quality Control tests and inspections to control production and construction processes. Include in the CONTRACTOR Quality Control system an internal organization, plans, and procedures to produce the specified end product. Assure the system covers all construction operations, both on-site and off-site, and is keyed to the construction sequence.

B. Construction Testing: Quality Control testing frequency is at the CONTRACTOR's discretion, except where tests are specifically required in the technical specifications for individual products and as follows.

1. Field Density: Quality Control density testing will be completed on all trenches, structural backfill, and on all improved surfaces/roadways crossings.

a. Field density tests of compacted backfill and gravel base course shall be performed at all levels and elevations, as noted.

b. Density tests performed to establish rolling patterns shall not be considered as testing to meet the minimum frequency.

c. Paved and Building Slab Areas: At subgrade and each 12" of compacted fill and backfill layer, at least one test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

2. Steel Reinforcement Placement: See Section 033000

3. Concrete Tests: See Section 033000

4. Quality Assurance testing frequency is at the ENGINEER's discretion.

C. Laboratory: The Quality Control tests are to be performed by an approved independent testing laboratory at the expense of the CONTRACTOR. Locations for testing shall be determined at random by the independent testing laboratory personnel. The method for selecting random locations shall be as established in the Quality Control Plan.

3.2 CONTRACTOR COOPERATION WITH QUALITY ASSURANCE AGENCY:

A. Access: CONTRACTOR shall assure that the OWNER's personnel and Quality Assurance agency has access to all work areas at all times work is in progress.

Provide any special facilities or equipment to access work areas at the CONTRACTOR’s expense.

B. Notification: CONTRACTOR shall notify the ENGINEER when the work is ready for Quality Assurance testing. Establish and update the construction schedule to provide the ENGINEER estimated sampling/testing dates and times.

C. Samples: All samples obtained for the purpose of determining a Proctor value for use in Quality Control must be split, and half of the sample shall provided to the ENGINEER. If a sample is obtained and the ENGINEER is not provided with a split of the material, the test results of the material in question will be unacceptable. CONTRACTOR shall provide adequate notice to the ENGINEER's representative so that they may be present to collect the sample.

3.3 PAYMENT FOR TESTING:

A. CONTRACTOR’s Cost: All Quality Control testing costs are incidental to the work and to be included in the CONTRACTOR’s bid. Mix designs for Portland cement concrete, flowable fill, and asphalt concrete, and all initial aggregate quality tests are considered Quality Control tests and are at the CONTRACTOR’s expense.

B. OWNER’s Cost: OWNER will pay for all Quality Assurance testing costs.

C. Retesting: Quality Assurance retesting due to failing initial tests will be performed by the OWNER or the OWNER’s Quality Assurance testing agency, and the retest costs will be deducted from the CONTRACTOR’s progress estimates.

- END OF SECTION -

SECTION 01 75 00 – STARTUP OF SYSTEMS/COMMISSIONING

PART 1 -- GENERAL

1.1 GENERAL

A. Satisfactory testing and startup of new and modified facilities are prerequisites to successful completion of the contract requirements and shall be completed within the Contract Times.

B. Conduct all testing, check-out, startup, and related requirements indicated in the Contract Documents and provide documentation of same to the ENGINEER prior to requesting Substantial Completion from the ENGINEER. Where manufacturer onsite inspections are required before startup, the manufacturer shall furnish a written statement that the installation and check-out are complete and proper and that the item(s) are ready for startup.

C. Startup of the treatment plant will require the combined expertise of the CONTRACTOR, subcontractors, NF manufacturer, ENGINEER, Systems Integrator, and OWNER. The CONTRACTOR shall be responsible for coordinating all parties for a successful startup: the ENGINEER and OWNER will be available for technical and operational advice prior to and during startup. The CONTRACTOR shall be on-site for all start-up efforts.

D. The Systems Integrator has designated roles as specified in Section 40 90 00 PROCESS CONTROL AND INSTRUMENTATION SYSTEMS COMMISSIONING of the Systems Integator Contract Documents. The CONTRACTOR shall refer to the Systems Integrator Invitation to Bid for delineation of responisibilities. The CONTRACTOR will be available to support the efforts of the filter automation start-up with the Systems Integrator.

E. The NF manufacturer has designated roles as specified in Section 46 07 13 NANOFILTRATION EQUIPMENT PACKAGE. The CONTRACTOR will be available to support the efforts of the NF Start-up, testing and training.

F. General requirements for startup activities are included in this Section. More specific requirements may also be included in other portions of the Contract Documents.

G. Temporary facilities may be necessary. If so, CONTRACTOR shall design, provide, operate, and later decommission them.

1.2 DEFINITIONS

A. Startup is defined as testing, demonstrations, and other activities as required to achieve Substantial Completion. Startup includes pre-commissioning and commissioning activities, manufacturer’s services, certifications of readiness for testing, and troubleshooting, checkout, and shakedown activities.

B. Pre-commissioning is the systematic demonstration through testing and extended operation that major equipment and auxiliary systems, including related components, sub-systems, and systems operate properly and consistent with their intended function.

1. Pre-commissioning shall simulate shutdown conditions, failure conditions, power fail and restart, bypass conditions, and failure resets. Pre-commissioning will not be considered complete until successful results and documentation of tests and manufacturer's certifications required by the Contract Documents are submitted and accepted by the ENGINEER. Pre-commissioning of all portions of the WORK shall be successfully completed prior to starting Commissioning.

C. Commissioning is the verification that the complete WORK functions on an extended basis in full conformance with the Contract requirements.

1.3 SUBMITTALS

A. **Schedule:** The schedule for startup shall be submitted in addition to the CONTRACTOR's overall CPM Construction Schedule.

B. **Startup and Commissioning Plan:** Not less than 30 Days prior to startup, submit for review a detailed Startup and Commissioning Plan. The CONTRACTOR shall revise the Plan as necessary based on review comments. The Plan shall include:

1. Schedules for manufacturers' equipment certifications

2. Schedules for submitting final Technical Manuals

3. Schedule for training the OWNER's personnel

4. Description of temporary facilities and schedule for installation and decommissioning them

5. List of OWNER and CONTRACTOR-furnished supplies

6. Detailed schedule of operations to achieve successful pre-commissioning and commissioning.

7. Checklists and data forms for each item of equipment

8. Coordination with the OWNER's staff, Systems Integrator, and the NF Supplier's staff

9. Designation of a representative of the CONTRACTOR who has the authority to act in matters relating to startup and has experience in testing and startup.

10. Designation of the roles and responsibilities of any Subcontractors that may be involved in startup activities.

11. Safety, startup, and testing procedures.

12. Proposed inspection and certification forms and records.

13. Interconnection of new to existing facilities

    a. Date and time frame of proposed shutdown or interconnection, including sequence of events and activities to be conducted.

    b. A detailed description of sequences and activities for the planned shutdown and interconnection.

c. Staff, equipment, and materials that will be at the Site before commencing the shutdown.

d. Other provisions so that interconnection, testing, and startup will be completed within the planned time.

14. Hydrostatic testing of water-holding structures and pipelines and other potable (If applicable) water equipment. Schedule and plan shall indicate source of water, testing and disinfection sequence, disinfection procedures, and the disposal of the water following disinfection, if applicable.

C. **System Outage Requests:** Request for shutdown of existing systems as necessary to test or start up new facilities.

D. Records and Documentation

1. Where required by the specifications, submit equipment installation certifications under those Sections.

2. Records of startup as indicated below.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL

A. Supplies

1. The CONTRACTOR shall furnish:

a. Necessary materials not listed for the OWNER to furnish

b. Power

1) Temporary power provisions shall be provided by the Contractor

2) Power and heating costs for operation of the treatment equipment and lighting, heating, ventilation of buildings will be responsibility of Contractor until substantial completion.

B. **Startup Records:** The CONTRACTOR shall maintain the following during testing and startup and submit originals to ENGINEER:

1. Lubrication and service records for each mechanical and electrical equipment item.

2. Hours of daily operation for each mechanical and electrical equipment item.

3. Equipment alignment and vibration measurement records.

4. Logs of electrical measurements and tests.

5. Instrumentation calibration and testing logs.

6. Testing and validation of inputs, outputs, logic functions, status indications, and alarms.

7. Factory and field equipment settings.

8. Log of problems encountered and remedial action taken.

9. Other records, logs, and checklists as required by the Contract Documents.

3.2 MALFUNCTIONS

A. During the extended operational demonstrations, all components, subsystems, systems, and equipment must properly run continuously 24 hours per day at rates indicated by the ENGINEER throughout the test period. Unless indicated otherwise, if any item fails or malfunctions during the test, the item shall be repaired and the test restarted at time zero with no credit given for the operating time before the failure or malfunction. Malfunctions satisfying all three of the following conditions will allow the demonstration period to resume at the elapsed time when the malfunction started:

1. Malfunction did not cause any interruption of the continuous operation of any other components, subsystems, systems, and equipment.

2. Malfunction was corrected without causing or requiring any components, subsystems, systems, and equipment to cease operations.

3. Malfunction was corrected within one hour of the time the malfunction was detected (the one hour period includes the time required to locate the cause of the malfunction, beginning upon CONTRACTOR’s notification from the ENGINEER that a malfunction has occurred and ending when the item is corrected and the system is successfully placed back into operation).

B. The CONTRACTOR shall arrange for manufacturer's representatives to visit the Site as often as necessary to correct malfunctions.

3.3 PREREQUISITES

A. Pre-commissioning and commissioning activities shall be scheduled according to CPM Construction Schedule protocols. The following shall be completed before pre-commissioning begins.

1. All Technical Manual information required by the Contract Documents has been submitted.

2. Safety equipment, emergency shower and eyewash units, fire extinguishers, gas detectors, protective guards and shields, emergency repair kits, safety chains, handrails, gratings, safety signs, and valve and piping identification required by the Contract Documents are provided. Devices and equipment shall be fully functional, adjusted, and tested.

3. Electrical tests, balancing, and adjustments have been completed.

4. The ENGINEER has approved the Startup Plan.

5. Temporary facilities are functional, adjusted, and ready for use.

6. Individual instrumentation loops (analog, status, alarm, and control) have been verified functionally.

7. Individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls have been verified.

3.4 PRE-COMMISSIONING

A. The Contractor shall complete a pre-commissioning to test all functionality, operation and alarms on equipment installed.

B. After individual equipment items and subsystems have been tested and certified as required by the Technical Specifications, tests of systems comprised of single or multiple equipment items with appurtenant equipment and instruments and controls shall be conducted. Items of equipment shall be tested as part of a system to the maximum extent possible.

C. The CONTRACTOR shall furnish the ENGINEER at least 10 Days written notice confirming the start of pre-commissioning. The OWNER's staff will observe pre-commissioning.

D. If any system malfunctions, the item or equipment shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.

E. The CONTRACTOR shall demonstrate the manual and automatic modes of operation to verify proper control sequences, proper operation of software logic and controllers, etc.

F. Systems testing activities shall follow the detailed procedures and checklists in the Testing and Startup Plan. Completion of systems shall be documented by a report.

G. The CONTRACTOR shall demonstrate utility, chemical feed, safety equipment, and other support systems before whole process systems.

3.5 COMMISSIONING

A. Testing periods shall not include holidays, based on the OWNER's calendar.

B. The CONTRACTOR shall start up the plant and operate it without malfunction for a continuous 14 Day, 24 hour/day period. The ENGINEER will determine the operational parameters. If any equipment item, subsystem, or system malfunctions, the item or equipment shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.

1. A total of 14 days (2 weeks) is allotted in the project schedule for the commissioning phase and accounted for in the time allowance to achieve substantial completion.

C. The CONTRACTOR shall furnish the ENGINEER at least 10 Days written notice confirming the start of commissioning. The OWNER's staff will observe commissioning.

D. Defects that appear shall be promptly corrected. Time lost for wiring corrections, control point settings, or other reasons that interrupt the test may, at the judgment of the ENGINEER, be cause for extending the demonstration an equal amount of time.

E. The CONTRACTOR shall furnish the services of manufacturers' representatives, if necessary, to correct equipment malfunctions and assist with the commissioning demonstration.

F. The OWNER will furnish plant operators during the startup period to comply with requirements for discharging water. Certified operators will be under the direct supervision of and be responsible to the OWNER but will operate the plant in accordance with the Startup and Commissioning Plan.

G. During the commissioning demonstration, the CONTRACTOR shall:

1. Lubricate and maintain equipment in accordance with the manufacturers' recommendations.

2. Perform other activities needed to maintain proper operation of the equipment and systems.

- END OF SECTION -

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 DESCRIPTION:

The following specification includes all work involved in final closeout of this Project. Included are items such as post construction inspection, acceptance of the Work, closeout records, cleaning, and project record drawings.

1.2 RELATED WORK:

Contract General Conditions

1.3 SUBMITTALS:

All required closeout submittals shall be reviewed by the ENGINEER prior to final payment. Items to be submitted are:

A. Guarantees and Bonds. Provide guarantees and bonds as required herein and as provided by manufacturers of all products and equipment.

B. Certification of Completion: Certifying completion of construction, compliance with the Contract Documents, and waiver of any claims.

C. Contractor's Affidavit of Release of Liens.

D. Final Waiver of Lien.

E. Consent for Surety to Final Payment:

F. Insurance Certificate: Certificate to indicate which insurance coverages required by Contract General Conditions that are to remain in effect after project is completed.

PART 2 - PRODUCTS

None.

PART 3 - EXECUTION

3.1 CLEANING:

Sweep paved surface, including all adjacent haul streets and other incidental areas, soiled during construction. All lawn or grassed areas shall be raked and cleaned to level and remove all rocks, stones or other debris from construction.

3.2 SUBSTANTIAL COMPLETION AND FINAL INSPECTION:

Submit written certification that project, or designated portion of Project, is substantially complete and request, in writing, a final inspection. The ENGINEER, OWNER, and any representatives of funding agencies will make an inspection within 10 days of receipt of any request.

Should the ENGINEER determine that the Work is substantially complete, he will prepare a punch list of deficiencies that need to be corrected before final acceptance, and issue a Notice of Substantial Completion with the deficiencies noted.

Should the ENGINEER determine that the Work is not substantially complete, he will immediately notify the CONTRACTOR, in writing, stating reasons. After the CONTRACTOR completes the Work, he shall submit certification and request for final inspection.

3.3 ACCEPTANCE OF THE WORK:

After all deficiencies have been corrected, a Letter of Final Acceptance will be issued. If only designated portions of the project have been inspected, a Letter of Partial Acceptance will be issued for that portion corrected.

Acceptance may be given prior to correction of deficiencies which do not preclude operation and use of the facility; however, final payment will be withheld until all deficiencies are corrected. Until receipt of the Letter of Final Acceptance, the CONTRACTOR shall be responsible for the Work of this Contract.

- END OF SECTION -

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

1.7 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Owner of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

D. Survey of Existing Conditions: Record existing conditions by use of measured drawings or preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.

3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

-END OF SECTION-

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Sections:

1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Proposed Mix Designs: Submit in accordance with ACI 301 at least 30 calendar days prior to first-scheduled concrete placement. Provide 28-day strength data for structural concrete and 56-day strength data for mass concrete where mix was used for previous projects within the last year, or minimum 28-day strengths for a new mix. Include laboratory test results, mill test reports, or certificates of compliance for each material used in concrete mixes.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Shop drawings shall comply with ACI 315 “Manual of Standard Practice for Detailing Reinforced Concrete Structures”.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

E. Related Materials: Product data for joint materials, waterstops, admixtures, curing materials, sealants, hardeners, bonding agents and other concrete related materials that are required or proposed.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Material certification tests and delivery certificates for Portland cement, fly ash and other cementitious admixtures.

C. Material test reports including certification tests for water and aggregates conforming to these specifications.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".
3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
4. ACI 304R, "Guide for Measuring, Mixing, Transporting and Placing Concrete".
5. ACI 304.2R, "Placing Concrete by Pumping Methods".
6. ACI 305R, "Hot Weather Concreting".
7. ACI 306.1 and 306R, "Cold Weather Concreting".
8. ACI 308R, "Guide to Curing Concrete".
9. ACI 309R, "Guide for Consolidation of Concrete".
10. ACI 318R, "Building Code Requirements for Structural Concrete".

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement; furthermore, all reinforcing steel shall be clean and free of mill scale, rust, debris and any other deleterious material prior to placement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 1 by 1 inch, minimum.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent

treatments of concrete surfaces. Interior basin and tank form coatings to comply with NSF 61 requirements for potable water.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 2 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious material, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II.

B. Normal-Weight Aggregates: ASTM C 33, graded.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

D. Grout: Proprietary, pre-mixed, non-ferrous, non-shrink grout conforming to Corps of Engineers specification CRD-C 621.

E. Adhesive: Use specified materials for securing dowels and fasteners to hardened concrete. Installation shall conform to the manufacturer’s recommendations and instructions.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 WATERSTOPS

A. Flexible PVC Waterstop: CE CRD-C 572 for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes. Waterstops shall be of an approved type, supplied by an approved manufacturer and shall be plastic made of virgin polyvinylchloride compound, shall be ribbed, uniform in dimensions, dense, homogeneous, free from porosity, and as detailed on the Drawings. No reclaimed PVC shall be used in the compound.

2.6 JOINT SEALERS

A. Joints shall be sealed with a mastic joint sealer material of uniform, stiff consistency that does not contain solvents.

B. The mastic shall tenaciously adhere to primed concrete surfaces, shall remain permanently mastic and shall not contaminate potable water. Product must be NSF 61 approved.

C. The material shall be of a type that will effectively and permanently seal joints subject to movements in concrete.

D. The mastic joint sealer shall be an acceptable two-part, non-sag (or self-leveling), non-staining, polyurethane elastomeric sealant which cures at ambient temperature. Acceptable sealants shall conform to ASTM C-920 or Federal Specification TT-S-00227E. Non-sag sealants are to be used on vertical applications while the self-leveling or non-sag sealants may be used in horizontal applications.

E. Acceptable polyurethane materials include SIKAFLEX/1a and SIKA-FLEX/2c NS and 2c SL POLYURETHANE ELASTOMERIC SEALANT, as manufactured by SIKA CHEMICAL CORP., Santa Fe Springs, CA (213-941-0231), or approved equal.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersable, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Adhesive Anchors: Hilti HIT-RE 500V3, HIT-HY150 MAX, or Simpson SET XP adhesive anchors. Install per manufacturer’s recommendations.

E. Expansion Anchors: Hilti Kwik Bolt TZ or Simpson Strong-Bolt expansion anchor. Install per manufacturer’s recommendations.

2.9 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

C. Proportion normal-weight concrete mixture as follows:

1. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

2. 28-day Compressive Strength: 4000 psi minimum for structural concrete and 3000 psi minimum for sidewalks, curbs and ramps.

3. Entrained air 5-7%, at point of placement for footings and slabs exposed to weather. Interior slabs-on-grade shall have no air entrainment.

4. Maximum-size aggregate: ¾ inch

5. Maximum water/cement ratio: 0.45

6. Minimum cement content: 611 lbs/cy (6.5 sack)

D. Slump Limits: Proportion and design mixes to result in a concrete slump at point of placement of:

1. Not less than 1” and not more than 4”.

2. When a high-range water-reducing admixture or a plasticizing admixture is approved, assure the concrete has a slump of 2” to 4” before the addition of the admixture, and a maximum slump of 8” at point of placement after admixture is added.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes or 250 revolutions of the mixing drum whichever occurs first.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Construct forms tight enough to prevent loss of concrete mortar.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

F. Chamfer exterior corners and edges of permanently exposed concrete per the Drawings.

G. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

I. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

J. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength and in the case of shored slabs no less than 14 days.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
2. Form keyed joints where indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate horizontal joints in walls and columns at underside of floors, slabs, and beams, and at the top of footings or floor slabs.
4. Space vertical joints in walls as indicated.
5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Cut joints no later than 18 hours after concrete has been placed.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.6 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. All Waterstops: Maintain continuity of waterstops at all intersections and transitions.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints. Lift heights shall not exceed 24 inches nor shall the fresh concrete be allowed to free fall more than 5 feet.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1.

F. Hot-Weather Placement: Comply with ACI 305 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 ORDER OF PLACING CONCRETE

A. General: The order of placing concrete shall be acceptable to the Engineer.

B. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by the construction joints at the indicated locations on the Drawings.

C. The placing of units shall be done by placing units diagonally starting at one corner. Sections are to be placed in a manner such that each unit placed shall have cured at least 5 days for hydraulic structures (basins and tanks) and 2 days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 10 days for hydraulic structures and 4 days for all other structures.

3.9 FINISHING FORMED SURFACES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to view.

B. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

1. Top of tanks and basin walls adjacent to walkways shall receive a porous trowel finish.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surface of footings and concrete that will not be exposed to view.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

1. Apply a trowel finish to surface of the exposed floor slab.
2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

D. Broom Finish: Apply a broom finish to elevated concrete slabs of tanks and basins, and exterior concrete walks, steps, ramps, utility pads, and elsewhere as indicated.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

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

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 CONCRETE FLOOR SEALING

A. Application of curing and sealing compound: Prepare, apply, and finish compound according to manufacturer's written instructions.

1. Remove oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Apply compound at the recommended coverage rate until the surface is saturated and then apply a second at the prescribed rate in accordance with the manufacturer’s written instructions.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Use non-shrink grout conforming to these specifications.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with grout

before bonding agent has dried. Fill form-tie voids with grout or cone plugs secured in place with epoxy bonding agent.

2. Repair defects on surfaces exposed to view using grout. Area beyond repaired defect shall be rubbed with a thin fluid layer of grout using burlap to match the surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact grout in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete.
3. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
4. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
5. Repair random cracks and single holes 1 inch or less in diameter with grout. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place grout before bonding agent has dried. Compact grout and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and grout.

F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.15 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engineer will perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
    b. Cast and field cure one set of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one laboratory-cured specimen at 7 days and one set of two specimens at 28 days. The fourth cylinder shall be held in reserve in the event the 28 day tests fail to meet the specified compressive strength.

    a. Test field-cured specimens as needed.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at 28 days.

7. When strength of field-cured cylinders is less than 85 percent of the companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

9. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by the Engineer.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.16 PROTECTION OF SEALED FLOOR

Protect sealed floor from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

- END OF SECTION -

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes structural steel.

1.2 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication details and erection plan of structural steel components.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Welding certificates.

C. Mill test reports for structural steel, including chemical and physical properties.

D. Source quality-control reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes & WT-Shapes: ASTM A 992/A 992M.

B. Channels, Angles: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

B. Headed Anchor Studs: ASTM A 108, Type A, headed-stud type, cold-finished carbon steel.

C. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Finish: Galvanized.

D. Threaded Rods: ASTM A 193 B7 or ASTM F 1554 Grade 36.

1. Finish: Galvanized.

2.3 COATINGS

A. Structural steel plates, shapes, bars and fabrications: Hot dip galvanize in accordance with ASTM A123 for sections exposed to weather in service; otherwise shop prime.

B. Structural steel hardware: Hot dip galvanize in accordance with ASTM A153 or mechanically deposited zinc coatings per ASTM B695.

C. Fasteners: Hot dip galvanize in accordance with ASTM 2329 or plating per ASTM F1941.

2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engineer will inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

1. In addition to visual inspection, field welds other than fillet welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at the Engineer's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents at no additional cost to the Owner.

- END OF SECTION -

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section contains requirements for the procurement, submission and execution for the construction of elements shown, called out or inferred to be configured of wood framing or wood panel elements. This will include miscellaneous items and hardware incidental to construction of those elements.

1.2 RELATED SPECIFICATIONS

A. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

B. Division 01 - General Requirements.

1.3 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A 153/153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
2. ASTM A 307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
3. ASTM A 563/563M – Standard Specification for Carbon and Alloy Steel Nuts
4. ASTM A 653/653M – Standard Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

B. American Forest and Paper Association (AF&PA)

1. AF&PA's WCD 1 - Details for Conventional Wood Frame Construction

C. American Lumber Standard Committee (ALSC) Board of Review

D. American Wood Protection Association (AWPA)

1. AWPA U1 – Use Category System: User Specification for Treated Wood

E. International Code Council (ICC)
1. ESR-1539, ICC Evaluation Service – Power Driven Staples and Nails

F. Forest Stewardship Council (FSC)

1. FSC STD-01-001, FSC Principles and Criteria for Forest Stewardship
2. FSC STD-40-004, FSC Standard for Chain of Custody Certification

G. International Building Code (IBC)

1. IBC Table 2304.9.1 Fastening Schedule

H. West Coast Lumber Inspection Bureau (WCLIB)

I. Western Wood Products Association (WWPA)

1.4 DEFINITIONS

1.5 SUBMITTALS

A. Action Submittals:

1. ICC-ES evaluation reports for wood-preservative treated wood, fire-retardant treated wood, engineered wood products and metal framing anchors.

B. Informational Submittals – Not Used

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Provide dressed lumber as noted on the drawings marked with grade stamp of inspection agency.

B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for PROJECT.

1. Allowable Design Stresses: Engineered wood products shall have allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be demonstrated by comprehensive testing.

2.2 TREATED MATERIALS

A. Preservative-Treated Materials: AWPA U1; Use Category UC1 for exterior construction not in contact with the ground, and use Category UC4B for items in contact with the ground.

1. Use treatment containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

B. Provide preservative-treated materials for items indicated on Drawings, and the following:

1. Wood sills, blocking, and similar concealed members in contact with masonry or concrete.
2. Wood framing members that are less than 18 inches above the ground.

2.3 FRAMING

A. Certified Wood: Wood framing shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

B. Dimension Lumber:

1. Maximum Moisture Content: 19 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal.
2. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
   a. Species: Douglas Fir or Southern Pine
   b. Grade: No. 2 or better

C. Timbers 5-Inch Nominal Size and Thicker: Select Structural No. 1: Douglas fir-larch; WCLIB, or WWPA.

1. Maximum Moisture Content: 19 percent

2.4 MISCELLANEOUS LUMBER

A. Miscellaneous Dimension Lumber: No. 2 grade with 19 percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.

2.5 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated. Where rough carpentry is 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.

1. Power-Driven Fasteners: CABO NER-272.
2. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

B. Metal Framing Anchors: Structural capacity, type, and size indicated.
1. Manufacturers: One of the following:

   a. Simpson Strong-Tie Co., Inc.
   b. USP Structural Connectors

2. Use anchors made from hot-dip galvanized steel complying with ASTM A 653/A 653M, G60 coating designation for interior locations where stainless steel is not indicated.

C. Sill Sealer: Glass-fiber insulation, 1 inch (25 mm) thick, compressible to 1/32 inch.

D. Flexible Flashing: Self-adhesive product consisting of a butyl rubber or rubberized-asphalt compound, bonded to a backing sheet to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Do not splice structural members between supports unless otherwise indicated.

D. Securely attach rough carpentry to substrates, complying with the following:

1. CABO NER-272 for power-driven fasteners.
2. Published requirements of metal framing anchor manufacturer.
3. Table 2304.9.1, "Fastening Schedule," in the IBC.

- END OF SECTION -

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

PART 2 - PRODUCTS

2.1 WALL SHEATHING

A. Plywood Sheathing: Exterior, Structural I.

2.2 ROOF SHEATHING

A. Plywood Sheathing: Exterior, Structural I.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated on the drawings that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:

a. Nail to wood framing.

- END OF SECTION -

SECTION 06 18 00 - GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes framing using structural glued-laminated timber.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with provisions in AITC 111.

B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 STRUCTURAL GLUED-LAMINATED TIMBER

A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
2. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.

B. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch that complies with combination symbols indicated.

C. Species and Grades for Beams:

1. Species and Beam Stress Classification: Douglas fir-larch, 24F-1.8E.
2. Lay-up: Balanced.

D. Species and Grades for columns:

1. Species and Combination Symbol: Douglas Fir-Larch Grade L2.

E. Appearance Grade: Industrial, complying with AITC 110.

2.2 TIMBER CONNECTORS

A. Manufacturers: One of the following:

1. Simpson Strong-Tie Co., Inc.
2. USP Structural Connectors

B. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
2. Round steel bars complying with ASTM A575, Grade M 1020.
3. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.

C. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

2.3 MISCELLANEOUS MATERIALS

A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.4 FABRICATION

A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.

B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.

C. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

D. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

C. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing.

1. Predrill for fasteners using timber connectors as templates.
2. Finish exposed surfaces to remove planing or surfacing marks.
3. Coat cross cuts with end sealer.

3.2 ADJUSTING

A. Repair damaged surfaces after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.3 PROTECTION

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.

1. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

- END OF SECTION -

SECTION 06 20 13 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Prefabricated cedar shingle panels and accessories for siding applications.

1.3 DEFINITIONS

A. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

1.5 INFORMATIONAL SUBMITTALS

A. Compliance Certificates:

1. For lumber that is not marked with grade stamp.
2. For preservative-treated wood that is not marked with treatment-quality mark.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.

C. Sample Warranties: For manufacturer's warranties.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
2. Provide for air circulation around stacks and under coverings.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece.

B. Hardboard: ANSI A135.4.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent, respectively.

2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
4. Do not use material that is warped or does not comply with requirements for untreated material.
5. Mark lumber with treatment-quality mark of an inspection agency approved by the ALSC's Board of Review.

6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

    a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

7. Application: All lumber within 6” of grade or in contact with concrete.

2.3 EXTERIOR TRIM

A. Lumber Trim for Clear Finish:

1. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Clear Heart VG (Vertical Grain).

2.4 LUMBER SIDING

A. Provide kiln-dried lumber siding complying with DOC PS 20.

B. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Clear VG (Vertical Grain) Heart.

C. Pattern: Bevel siding, S1S2E, actual overall dimensions of 5-1/2 by 11/16 inch (140 by 17 mm), measured on the face and thick edge.

2.5 INTERIOR PLYWOOD

A. Plywood Sheathing: Exterior sheathing.

B. Nominal Thickness: Not less than 1/2 inch (13 mm).

C. Class C Interior Finish

1. Flame Spread Rating: 75-200
2. Smoke-developed index <450

2.6 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. For face-fastening siding, provide ringed-shank siding nails or hot-dip galvanized-steel siding nails unless otherwise indicated.
2. For prefinished items, provide matching prefinished aluminum fasteners where face fastening is required.
3. For pressure-preservative-treated wood, provide stainless steel or hot-dip galvanized-steel fasteners.
4. For applications not otherwise indicated, provide stainless stee or hot-dip galvanized-steel fasteners.

B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

C. Flashing: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

1. Horizontal Joint Flashing for Panel Siding: Preformed, galvanized-steel or stainless steel, Z-shaped flashing.

2.7 FABRICATION

A. Back out or kerf backs of standing and running trim wider than 5 inches (125 mm), except members with ends exposed in finished work.

B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut exterior finish carpentry to fit adjoining work.
3. Refinish and seal cuts as recommended by manufacturer.
4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
5. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.
6. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install flat-grain lumber with bark side exposed to weather.

B. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary.

1. Use scarf joints for end-to-end joints.
2. Stagger end joints in adjacent and related members.

C. Fit exterior joints to exclude water.

1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.5 SIDING INSTALLATION

A. Install siding to comply with manufacturer's written instructions and warranty requirements.

B. Horizontal Lumber Siding:

1. Apply starter strip along bottom edge of sheathing or sill.

2. Install first course of siding, with lower edge at least 1/8 inch (3 mm) below starter strip and subsequent courses lapped 1 inch (25 mm) over course below.

    a. Nail at each stud.
    b. Do not allow nails to penetrate more than one thickness of siding.

3. Leave 1/8-inch (3-mm) gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
4. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
5. Install prefabricated outside corners as recommended by manufacturer of siding materials.

3.6 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements.

    1. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

B. Adjust joinery for uniform appearance.

3.7 CLEANING

A. Clean exterior finish carpentry on exposed and semi-exposed surfaces.

3.8 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

    1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
    2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

- END OF SECTION -

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Glass-fiber blanket.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded Polystyrene Board, Type X: ASTM C 578, Type X, 15-psi (104-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

2.2 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:

    a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

-END OF SECTION-

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SECTION 072600 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyethylene vapor retarders.
2. Reinforced-polyethylene vapor retarders.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 10-mil- (0.15-mm-) thick sheet, with maximum permeance rating of 0.1 perm (5.7 ng/Pa x s x sq. m).

2.2 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Place vapor retarders on side of construction indicated on Drawings.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other

anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

-END OF SECTION-

SECTION 074113 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes standing-seam metal roof panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with metal panel Installer, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680[or ASTM E 283] at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646[or ASTM E 331] at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces

2.2 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.

A. Integral-Standing-Seam Metal Roof Panels: Formed with integral ribs at panel edges and [intermediate stiffening ribs symmetrically spaced] [a flat pan] between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and lapping and interconnecting side edges of adjacent panels.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AEP Span (Basis of Design: Klip-Rib)

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Nominal Thickness: Min. 26 gauge
b. Exterior Finish: Three-coat fluoropolymer
c. Color: As selected by Architect from manufacturer's full range

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Grace.
b. Henry Company.
c. Owens Corning.

B. Felt Underlayment: ASTM D 226/D 22M, Type II (No. 30), asphalt-saturated organic felts.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match roof fascia and rake trim.

E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads.

G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and

remain weathertight; and as recommended in writing by metal panel manufacturer.

3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable

variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:
   1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

   1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
   2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

      a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between

courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the roof area indicated below:

    a. Roof perimeter for a distance up from eaves of 36 inches (914 mm) beyond interior wall line.
    b. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches (460 mm).

B. Felt Underlayment: Apply at locations indicated below, in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).

1. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches (75 mm), in shingle fashion to shed water.

3.4 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c.

using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

J. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

-END OF SECTION-

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SECTION 074213 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exposed-fastener, lap-seam metal wall panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with metal panel Installer, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel systems during and after installation.
8. Review procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa)

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa)

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces

2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.

B. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced major ribs.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AEP Span (Basis of Design: PBR Panel)

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Nominal Thickness: Min. 26 gauge
b. Exterior Finish: Three-coat fluoropolymer
c. Color: As selected from manufacturer's full range

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:
1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form

expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

-END OF SECTION-

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Formed roof-drainage sheet metal fabrications.
   2. Formed steep-slope roof sheet metal fabrications.
   3. Formed wall sheet metal fabrications.
   4. Formed equipment support flashing.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

   1. For copings and roof edge flashings that are SPRI ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. FM Approvals Listing: Manufacture and install roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-60 Identify materials with name of fabricator and design approved by FM Approvals.

D. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 180 deg F (100 deg C), material surfaces

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation or [aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40]; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As selected by Architect from manufacturer's full range
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Galvanized Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation, Grade 40.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners**,** protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

I. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

1. Gutter Profile: Style A according to cited sheet metal standard.
2. Expansion Joints: Lap type.
3. Accessories: Wire-ball downspout strainer.
4. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:

    a. Galvanized Steel: 0.022 inch (0.56 mm) thick.

B. Downspouts: Fabricate round downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.

1. Manufactured Hanger Style: Fig 1-34A according to SMACNA's "Architectural Sheet Metal Manual."
2. Fabricate from the following materials:

    a. Galvanized Steel: 0.022 inch (0.56 mm) thick.

C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

2.6 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Eave, Rake, Ridge Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

B. Counterflashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) thick.

C. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Anchor gutter with straps spaced not more than 24 inches (600 mm) [apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.

C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.

C. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with [elastomeric] [butyl] sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.8 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

-END OF SECTION-

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SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.5 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
1. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.

D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under product category Expansion/Seismic Joints or Firestop Systems.

C. Wall-to-Wall, Joint Firestopping Systems:

1. Assembly Rating: 1 hour.
2. Nominal Joint Width: As indicated.
3. Movement Capabilities: Class I.
4. L-Rating at Ambient: Less than 5 cfm/ft. (0.0075 cu. m/s x m) of joint at 0.30 inch (7.47 Pa).
5. L-Rating at 400 Deg F (204 Deg C): Less than 5 cfm/ft. (0.0075 cu. m/s x m) of joint at 0.30 inch (7.47 Pa).
6.

D. Head-of-Wall, Fire-Resistive Joint Firestopping Systems:

1. Assembly Rating: 1 hour.
2. Nominal Joint Width: As indicated.
3. Movement Capabilities: Class I.
4. L-Rating at Ambient: Less than 5 cfm/ft. (0.0075 cu. m/s x m) of joint at 0.30 inch (7.47 Pa).
5. L-Rating at 400 Deg F (204 Deg C): Less than 5 cfm/ft. (0.0075 cu. m/s x m) of joint at 0.30 inch (7.47 Pa).

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.1 URETHANE JOINT SEALANTS (Exterior)

A. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Corp. - Construction Chemicals.
b. Pecora Corporation.
c. Sherwin-Williams Company (The).

2.2 MILDEW-RESISTANT JOINT SEALANTS (Interior)

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation.
b. GE Construction Sealants; Momentive Performance Materials Inc.
c. Pecora Corporation.
d. Tremco Incorporated.

2.3 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adfast.
b. Alcot Plastics Ltd.
c. BASF Corp. - Construction Chemicals.
d. Construction Foam Products; a division of Nomaco, Inc.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written

instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Construction joints in cast-in-place concrete.
    b. Joints between plant-precast architectural concrete units.
    c. Joints between metal panels.
    d. Joints between different materials listed above.
    e. Perimeter joints between materials listed above and frames of doors, windows and louvers.
    f. Control and expansion joints in ceilings and other overhead surfaces.
    g. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Control and expansion joints on exposed interior surfaces of exterior walls.
    b. Vertical joints on exposed surfaces of walls and partitions.
    c. Other joints as indicated on Drawings.

2. Joint Sealant: Mildew Resistant Silicone
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Perimeter joints between interior wall surfaces and frames of interior doors.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. All interior locations

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Exterior standard steel doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Amweld Building Products, LLC.
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Deansteel Manufacturing Company, Inc.
6. Firedoor Corporation.

7. Fleming Door Products Ltd.; an Assa Abloy Group company.
8. Habersham Metal Products Company.
9. Karpen Steel Custom Doors & Frames.
10. Kewanee Corporation (The).
11. Mesker Door Inc.
12. Pioneer Industries, Inc.
13. Security Metal Products Corp.
14. Steelcraft; an Ingersoll-Rand company.
15. Windsor Republic Doors.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.38 deg Btu/F x h x sq. ft. (2.16 W/K x sq. m) when tested according to ASTM C 518.

2.3 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A40 (ZF120) coating.
d. Edge Construction: Model 1, Full Flush.
e. Edge Bevel: [Bevel lock and hinge edges 1/8 inch in 2 inches (3.2 mm in 51 mm)] [Bevel lock edge 1/8 inch in 2 inches (3.2 mm in 51 mm)] [Provide manufacturer's standard beveled or square edges].
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors[where required for attachment of weather stripping] with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Manufacturer's standard, Polystyrene, Polyurethane, Polyisocyanurate at manufacturer’s discretion.
i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.

2. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120).
   b. Construction: Two piece thermally broken Full profile welded with butyl or manufacturer's standard thermal break separator material.

3. Exposed Finish: Prime.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

2.5 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

2.6 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

3. Terminated Stops: Terminate stops [6 inches (152 mm)] above finish floor with a 90-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standard specification.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Solidly pack mineral-fiber insulation inside frames.
4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8 or NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

3.3 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

-END OF SECTION-

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SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes manually operated sectional doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied finishes.

1. Include Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sectional doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Failure of components or operators before reaching required number of operation cycles.
c. Faulty operation of hardware.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
e. Delamination of exterior or interior facing materials.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain sectional doors from single source from single manufacturer.

1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other

defects in construction and without requiring temporary installation of reinforcing components.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings
2. Testing: According to ASTM E 330
3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.

    a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
    b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.

4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

C. Windborne-Debris Impact Resistance: Provide sectional doors that pass missile-impact and cyclic-pressure tests according to ASTM E 1996 for Wind Zone 3.

D. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.25

2.3 DOOR ASSEMBLY

A. Steel Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Haas Door
2. Overhead Door Corporation

C. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

D. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

E. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. (2.03 L/s per sq. m)] at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283 or DASMA 105.

F. R-Value: 17.66

G. Steel Sections: Zinc-coated (galvanized) steel sheet with G60 (Z180) zinc coating.

1. Section Thickness: 2 inches (51 mm).
2. Exterior-Face, Steel Sheet Thickness: 0.028-inch- (0.71-mm-)nominal coated thickness.

    a. Surface: Flat.
    b. Surface: Manufacturer's standard, grooved

3. Insulation: Foamed in place.
4. Interior Facing Material: Zinc-coated (galvanized) steel sheet with a nominal coated thickness of 0.028 inch (0.71 mm).
5. Interior Facing Material: 1/8-inch- (3.2-mm-) thick, manufacturer's standard material.

H. Track Configuration: Standard-lift

I. Weatherseals: Fitted to bottom and top and around entire perimeter of door.

J. Roller-Tire Material: Manufacturer's standard.

K. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: operable from inside with thumbturn and outside with cylinder.

L. Counterbalance Type: Torsion spring.

M. Manual Door Operator: Chain-hoist operator.

N. Door Finish:
1. Finish of Interior Facing Material: Finish as selected by Architect from manufacturer's full range.

2.4 STEEL DOOR SECTIONS

A. Exterior Section Faces and Frames: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated zinc coating and thickness.

1. Fabricate section faces from single sheets to provide sections not more than 24 inches (610 mm) high and of indicated thickness. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weather-resistant seal, with a reinforcing flange return.
2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.

B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.064-inch- (1.63-mm-) nominal coated thickness and welded to door section. Provide intermediate stiles formed from

not less than 0.064-inch- (1.63-mm-) thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches (1219 mm) apart.

C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal.

D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.

E. Provide reinforcement for hardware attachment.

F. Board Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free polystyrene or polyurethane board insulation, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84; or with glass-fiber-board insulation. Secure insulation to exterior face sheet. Enclose insulation completely within steel sections and the interior facing material, with no exposed insulation.

G. Foamed-in-Place Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within steel sections and the interior facing material, with no exposed insulation.

H. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.

I. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.

J. Fabricate sections of mortise-and-tenon construction with waterproof glue and steel dowels, or of rabbeted construction with waterproof glue and steel dowels and pins.

K. Reinforce sections with continuous horizontal and diagonal galvanized-steel members as required to stiffen door and for wind loading.

L. Treat wood door members after machining with water-repellent preservative formulation according to WDMA I.S. 4.

M. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, deformation, and delamination.

N. Factory prime door sections with one coat of exterior primer compatible with field-applied finish, applied at a minimum dry film thickness of 1 mil (0.025 mm).

2.5 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.

1. Galvanized Steel: ASTM A 653/A 653M, minimum G60 (Z180) zinc coating.
2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device.

    a. For Vertical Track: Continuous reinforcing angle attached to track and attached to wall with jamb brackets.
    b. For Horizontal Track: Continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.

B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

2.6 HARDWARE

A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch- (2.01-mm-) nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet (4.88 m) wide unless otherwise recommended by door manufacturer.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- (76-mm-) diameter roller tires for 3-inch- (76-mm-) wide track and 2-inch- (51-mm-) diameter roller tires for 2-inch- (51-mm-) wide track.

D. Push/Pull Handles: Equip each push-up operated or emergency-operated door with galvanized-steel lifting handles on each side of door, finished to match door.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Cylinders standard with manufacturer and keyed to building keying system.
2. Keys: Three for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

2.8 COUNTERBALANCE MECHANISM

A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

B. Weight Counterbalance: Counterbalance mechanism consisting of filled pipe weights that move vertically in a galvanized-steel weight pipe. Connect pipe weights with cable to weight-cable drums mounted on torsion shaft made of steel tube or solid steel.

C. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet (4.88 m) long and two additional brackets at one-third points to support shafts more than 16 feet (4.88 m) long unless closer spacing is recommended by door manufacturer.

D. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.

E. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.

F. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.

G. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.9 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches (610 mm) apart.

2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.

1.3 COORDINATION

A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.

1. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors,

frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

    a. Identification number, location, hand, fire rating, size, and material of each door and frame.
    b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
    c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
    d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
    e. Fastenings and other installation information.
    f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
    g. Mounting locations for door hardware.
    h. List of related door devices specified in other Sections for each door and frame.

C. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of

manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys to Owner by registered mail or overnight package service.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of door hardware from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa)] of water.

C. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design".

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled in Part 3.

2.4 HINGES

A. Hinges: BHMA A156.1.Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Hager Companies.
c. McKinney Products Company; an ASSA ABLOY Group company.
d. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
3. Deadbolts: Minimum 1.25-inch (32-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:

1. Description: Manufacturer's design designation.
2. Levers: Forged or Cast.
3. Escutcheons (Roses): Forged.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Mortise Locks: BHMA A156.13; Security Grade 1; stamped steel case with steel or brass parts; Series 1000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Best Access Systems; Stanley Security Solutions, Inc.
c. Hager Companies.

2.6 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.7 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. Existing System:

a. Master key or grand master key locks to Owner's existing system.
b. Re-key Owner's existing master key system into new keying system.

B. Keys: Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: Information to be furnished by Owner.

2.8 OPERATING TRIM

A. Operating Trim: BHMA A156.6; Match existing.

2.9 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Hager Companies.
c. Norton Door Controls; an ASSA ABLOY Group company.
d. SARGENT Manufacturing Company; ASSA ABLOY.
e. Stanley Commercial Hardware; a division of Stanley Security Solutions.
f. Yale Security Inc; an ASSA ABLOY Group company.

2.10 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.11 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Hager Companies.
b. National Guard Products, Inc.
c. Pemko Manufacturing Co.

B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.12 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.13 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

    a. Wood or Machine Screws: For the following:

        1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
        2) Strike plates to frames.
        3) Closers to doors and frames.

    b. Steel Through Bolts: For the following unless door blocking is provided:

        1) Surface hinges to doors.
        2) Closers to doors and frames.
        3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.14 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.8 DOOR HARDWARE SCHEDULE

HW-1

3	Hinges	ST	
1	Lockset	BE	
1	Door Stop	IV	
1 set	Gasketing	NA	5050 B Head & Jambs
1	Threshold		
1	Closer	LCN	

HW-2

1	Cylinder	BE	

HW-3

3	Hinges	ST	
1	Lockset	BE	
1	Door Stop	IV	
1 set	Gasketing	NA	5050 B Head & Jambs
1	Closer	LCN	

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SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

1. Concrete.
2. Wood.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Behr Process Corporation.
2. Benjamin Moore & Co.
3. Dunn-Edwards Corporation.
4. Glidden Professional.
5. PPG Paints.
6. Rodda Paint Co.
7. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As indicated in a color schedule

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Wood: 15 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:

1. Solvent-Based Concrete Floor Sealer System MPI INT 3.2F:

    a. First Coat: Sealer, solvent based, for concrete floors, matching topcoat.
    b. Topcoat: Sealer, solvent based, for concrete floors, MPI #99.

B. Wood Substrates: Exposed framing.

1. Latex over Latex Primer System MPI INT 6.2D:

    a. Prime Coat: Primer, latex, for interior wood, MPI #39.
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

C. Wood Substrates: Wood trim and wood board paneling.

1. Latex over Latex Primer System MPI INT 6.3T:

    a. Prime Coat: Primer, latex, for interior wood, MPI #39.
    b. Intermediate Coat: Latex, interior, matching topcoat.
    c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

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SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of wood stains and transparent finishes**.** on the following substrates:

1. Exterior Substrates:

a. Exposed glued-laminated beams and columns.
b. Exposed framing.

B. Related Requirements:

1. Section 099123 "Interior Painting" for stains and transparent finishes on concrete floors.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

2. Indicate VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures less than 5 deg F (3 deg C) above the dew point, or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Behr Process Corporation.
2. Benjamin Moore & Co.
3. Coronado Paint; Benjamin Moore Company.
4. Dunn-Edwards Corporation.
5. Glidden Professional.
6. Rodda Paint Co.
7. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
8. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in wood finish systems schedules for the product category indicated.

2.2 MATERIALS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

D. Exterior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Prime edges, ends, faces, undersides, and backsides of wood.

a. For solid hide stained wood, stain edges and ends after priming.
b. For varnish-coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.

3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

E. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
3. Sand surfaces exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates: Glued-laminated construction.

1. Clear, Two-Component Polyurethane Varnish over Stain System MPI EXT 6.1E:

a. Stain Coat: Stain, exterior, solvent based, semitransparent, MPI #13.

b. First Intermediate Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
c. Second Intermediate Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
d. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or 7), MPI #78.

B. Wood Substrates: Exposed framing.

1. Semitransparent Stain System MPI EXT 6.2L:

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent, MPI #13.

C. Wood Substrates: Wood trim and wood board siding.

1. Semitransparent Stain System MPI EXT 6.3D:

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent, MPI #13.

- END OF SECTION -

SECTION 10 28 24 – CHEMICAL SAFETY EQUIPMENT

PART 1 - GENERAL

1.1 BASIS

A. The equipment outlined in this document is required for the new room where the NF skid is located in the water treatment plant. All equipment is required on site prior to start-up activities.

1.2 SECTION REQUIREMENTS

A. Submittals: Product Data adequate to demonstrate compliance with any and all specifications outlined in this document and referenced specifications.

PART 2 - PRODUCTS

2.1 COMBINATION SAFETY SHOWER AND EMERGENCY EYEWASH

A. Manufacturers (pre-approved, engineering approved equals accepted):

1. Bradley Model S19-310PVC, Bradley Corp., P.O. Box 309, Menomonee Falls, WI 53052-0309, 800-272-3539, 262-251-6000, bradleycorp.com

2. Econ Model 01060021, Econ Safety Products, 6825 W. Sam Houston Pkwy. N, Houston, TX 77041, (713) 466-1449, 800-283-6266, enconsafety.com

B. Basis-of-Design Product: Provide a combination drench shower and eye wash:

1. Materials: Stainless Steel, yellow painted steel, or PVC

2. Height: 39-inches

3. Eye wash nozzle covers: Nylon “Flip Top” Dust Covers

4. Eye wash activates by flag handle or foot pedal, safety shower activates by pull handle

5. Standards: ANSI Z358.1-2009

2.2 SAFETY EQUIPMENT:

A. The following safety equipment is required:

1. 1 pair of shoulder length, neoprene gloves

2. 1 rubber apron

3. 1 Full face shield, 8 inch minimum.

4. 1 Wall mounted fire extinguisher UL size 3-A:40-B:C

2.3 TEMPERED WATER VALVE:

A. Manufacturers (pre-approved, engineering approved equals accepted):

1. Bradley Model TMV25 S59-2025, Bradley Corp., P.O. Box 309, Menomonee Falls, WI 53052-0309, 800-272-3539, 262-251-6000, bradleycorp.com

B. Basis of Design: Provide a thermostatic control valve sized to match the flow requirements of the provided combination emergency safety shower and eyewash station.

1. Set tempered water outlet temperature to 95°F.

2. Standards: ANSI Z358.1-2009 and NSF rated for potable water use

3. Lead free brass body

4. Integral thermometer on tempered water outlet

2.4 WARNING SIGNS:

A. One Required:

1. Minimum dimensions: 10 inches x 14 inches

2. Material: 1/4 inch thick polyethylene.

3. Letter Color: Red and black on a white background

4. Sign Information: DANGER WEAR PROTECTIVE SAFETY EQUIPMENT WHEN HANDLING CHEMICALS

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install new safety shower / eye wash as shown on the drawings, new tempered water control valve, and new tempered water line from valve to BOTH new and existing safety shower eye/wash per manufacturers recommendations and instructions.

B. Install using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

C. Adjust for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

- END OF SECTION -

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 BASIS

A. This Specification includes water piping inside the building for water service to hand sinks, water heater, safety showers, or other equipment that requires potable water service inside the water treatment plant, excluding equipment and piping in the water treatment process.

1.2 SECTION REQUIREMENTS

A. Submittals: Product Data adequate to demonstrate compliance with any and all specifications outlined in this document and referenced specifications.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Potable water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

B. Process piping may be stainless steel (304 minimum), ductile iron, or Schedule 80 PVC. See building mechanical drawings and specifications for plumbing work.

C. All new work must be compliant with local plumbing code and/or IBC latest edition.

2.2 PIPE AND FITTINGS

A. PVC Piping: ASTM D 1785, Schedule 80 pipe using ASTM D 2467, solvent weld type fittings.

1. Connections: 150 Class flanged connections, Van Stone style for connections to valve, flow meters, pumps; solvent weld elsewhere. Comply with manufacturer’s recommendations for glue (IPS PVC 711) and primer (IPS P-70).

2. Flanges: class 125, true 90° with the pipe axis, hex head stainless steel bolts and nuts.

B. Pipe Supports:

1. Supports and restraints shall be designed and provided to prevent excessive movement and separation during operation.

2. Sized with a capacity safety factor of 5:1.

3. Maximum pipe deflection under full load to be 1/8-inch.

4. Follow manufacturer's recommendations on support spacing.

5. Determine and provide all required mounting equipment and supports.

6. Manufacturer: ITT Grinnell or equal.

C. Pipe Sleeves:

1. Use "Link Seal" LS-200 (or equal) EPDM black rubber seals with 316SS hardware for all pipe to wall or pipe to floor penetrations to provide a seal between concrete and pipe where water tight seals are required.

2. No pipe sleeves are required for wall penetrations through stud framed walls. Seal these wall penetrations with expanding foam sealant as required for insulation and to protect wall materials from water ingress.

PART 3 - EXECUTION

3.1 INSTALLATION

Piping Installation:

A. Contractor shall install all piping, valves, hangers, supports, fittings, and appurtenances required for a fully functional piping system.

B. Provide a minimum of one (1) sample tap, and pressure gauge upstream of any chemical injection point.

C. Provide a minimum of one (1) sample tap, and pressure gauge downstream of any chemical injection point.

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight.

3.2 INSPECTING AND CLEANING

A. Inspect and test piping systems as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. All systems shall be subjected to operating conditions. Based upon visual observations, any leaks, vibrations, deflections, or stress in the piping system shall be corrected to the satisfaction of the Owner's Representative.

B. Contractor shall test the bacteriological quality of the installed equipment after the pressure test. Disinfection shall comply with AWWA C653-13 (or latest edition).

- END OF SECTION -

SECTION 23 00 00 – HEATING VENTILATION AND AIR CONDITIONING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all Heating Ventilation and Air Conditioning work, complete and operable, in accordance with the Contract Documents.

1.2 SUMMARY

A. Section Includes:

1 Fuel oil fired heaters

2 Exhaust Fans

3 Circulation Fans

4 Ductwork

5 Dampers & Louvers

6 Duct Insulation

7 Fuel oil piping and associated components

1.3 REFERENCE STANDARDS

A. The Work of this Section shall comply with the following, as applicable:

IMC	International Mechanical Code
UPC	Uniform Plumbing Code

B. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or other State of Alaska recognized testing laboratory.

C. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards, state building standards, and applicable local codes and regulations.

1.4 PERMITS AND INSPECTION

A. All required permits shall be obtained and inspection fees shall be paid by the CONTRACTOR.

1.5 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 Submittals Procedure.

B. Shop Drawings: Include the following:

1 Product Data:

2 Component data.

3 Test reports.

4 Catalog cuts of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material. Catalog data sheets shall be stamped to indicate the project name, applicable Section and paragraph; and shall be clearly marked to indicate exact model number, and options being provided.

5 Shop Drawings shall be custom prepared. Drawings or data indicating "optional" or "as required" equipment are not acceptable. Options not proposed shall be crossed out or deleted from Shop Drawings.

6 Materials and Equipment Schedules: The CONTRACTOR shall deliver to the ENGINEER within 30 days of the commencement date in the Notice to Proceed, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and other such information required to identify the items.

7 Owner's Manuals: Complete information in accordance with Section 01 33 00.

8 Record Drawings: The CONTRACTOR shall show invert and top elevations and routing of all duct banks and concealed below-grade electrical installations. Record Drawings shall be prepared, be available to the ENGINEER, and be submitted according to Section 01 33 00.

1.6 TESTS

A. The CONTRACTOR shall be responsible for factory and field tests required by specifications and applicable codes or authority having jurisdiction. The CONTRACTOR shall furnish necessary testing equipment and pay costs of tests, including all replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

B. Field test reports shall be submitted for review prior to Substantial Completion.

C. Equipment or material which fails a test shall be removed and replaced.

1.7 DEMOLITION AND RELATED WORK

A. The CONTRACTOR shall perform HVAC demolition WORK as indicated on the drawings. Coordinate with all trades and the overall sequence of construction.

1.8 CONSTRUCTION SEQUENCING

A. Continuance of facility operation during demolition and construction is critical at this facility. Therefore, the CONTRACTOR shall carefully examine all work to be done in, on, or adjacent to existing equipment. Work shall be scheduled, subject to the OWNER's approval, to minimize required process or equipment shutdown time. The CONTRACTOR shall submit a written request including sequence and duration of activities to be performed during plant shutdown.

1.9 QUALITY ASSURANCE

A. Ductwork

1 Perform Work in accordance with SMACMA HVAC Duct Construction Standards – Metal and Flexible.

B. Fuel Piping

1 Perform Work according to NFPA 31.

2 List and label flexible connectors and hoses according to UL 536.

3 Perform Work according to ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

PART 2 -- PRODUCTS

2.1 FUEL OIL FIRED HEATERS

A. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner, controls, and accessories:

1 Oil fired, sealed direct vented. 40,000 BTUH rating, with high, medium, and low fire capability. 0.3 gal/hr fuel consumption, 87% AFUE rating. Kerosene, No 1 fuel oil, or No, 1 Diesel capable. 120V AC, 275 watts. cETL listed.

2 Through wall flue pipe with wall vent cap and integral combustion air inlet.

3 Integral control system with room temperature, setpoint and error code display, 24 hour timer and setback thermostat. Safety shutoff system

B. Toyotomi, L73 Toyostove, or equal.

2.2 EXHAUST FANS

A. Inline Centrifugal direct driven type. UL Listed.

1 Fan housing constructed of flame retardant polycarbonate thermoplastic with integral round duct inlet and outlet collars and sealed joints.

2 Fan wheel: Backward inclined centrifugal type with inlet venture. Fan wheel and motor statically and dynamically balanced as a unit.

3 Motor: External rotor type totally enclosed PSC type rated for continuous duty with permanently sealed self-lubricating ball bearings and automatic reset thermal overload protection. 120 VAC, single phase, 80 Watts.

4 Performance: 150 CFM at 0.2 inches water column.

5 Fantech FR110 or equal.

2.3 CIRCULATION FANS

A. Ceiling mounted circulation fans – propeller type. ETL Listed, Energy Star rated.

1 Airfoil blades, 52 inch diameter. Ceiling pendant mount for flat or sloped ceiling.

2 Motor: High efficiency brushless DC variable speed with digital inverter drive.

3 Wall mounted control switch/speed control.

4 Performance: 181 RPM maximum speed, 1675 CFM minimum / 5604 CFM maximum. 18.6 Watt fan power consumption.

5 Big Ass Fan, Haiku L model, or equal.

2.4 GALVANIZED-STEEL DUCTS:

A. Material: ASTM A653 galvanized-steel sheet.

B. Quality: Lock forming.

C. Finish: G90 zinc coating according to ASTM A90.

D. Fasteners: rivets, bolts, or sheet metal screws.

2.5 DUCT ACCESSORIES

A. Backdraft Dampers: Constructed of aluminum or galvanized steel with gravity balanced blades. Blades shall have felt or flexible vinyl sealed edges. Ruskin or equal.

2.6 DUCT FABRICATION

A. Rectangular Ducts:

1 According to SMACNA standards.

2 Provide duct material, gages, reinforcing, and sealing for 1/2 inch water column operating pressures.

B. Round Ducts:

1 According to SMACNA standards.

2 Seams: Longitudinal or spiral.

3 Provide duct material, gages, reinforcing, and sealing for 1/2 inch water column operating pressures.

C. Tees, Bends, and Elbows:

1 Minimum Radius:

a 1.5 times centerline duct width.

b If not possible or if rectangular elbows are used, provide turning vanes.

D. Sealing:

1 Seal joints between duct sections and duct seams with gaskets or mastic adhesives,.

2 Sealants and Mastics: Comply with UL 181A and provide products bearing appropriate UL 181A markings.

E. Hangers and Supports:

1 Hanger Rods: Electrogalvanized, all-thread rods or galvanized.

2 Strap and Rod Sizes:

a Comply with SMACNA standards.

2.7 LOUVERS

A. Intake Louvers:

1 Stationary blade type with downspouts in frames to drain water cascading from above the louver.

2 Frame: 4-inch depth with integral flanges, extruded from 6063T5 aluminum of 0.081 inch nominal thickness

3 Blades: Extruded 6063T5 aluminum of 0.081 inch nominal thickness set at 37.5 degrees and spacing of approximately 5 inches.

4 Bird screen: Expanded and flattened 0.051 inch thick aluminum with 5/8-inch openings in removable frame located on the inside of the louver.

5 Size as shown on the drawings.

6 Ruskin ELF375X or equal.

B. Exhaust Louver/Damper

1 Combination stationary blade / backdraft blade type.

2 Frame shall be 4-inch depth with integral flanges, extruded from 6063T5 aluminum of 0.081 inch nominal thickness

3 Louver Blades: Extruded 6063T5 aluminum of 0.081 inch nominal thickness J-style set at 45 degrees and spacing of approximately 5 inches.

4 Backdraft Blades: Extruded 6063T5 aluminum of 0.050 inch nominal thickness with extruded vinyl edge seals.

5 Bird screen: Expanded and flattened 0.051 inch thick aluminum with 5/8-inch openings in removable frame located on the inside of the louver.

6 Size as shown on the drawings.

7 Ruskin ELBD813 or equal.

2.8 CONTROL AIR DAMPERS

A. AMCA Class 2 Low Leakage opposed blade type.

B. Frame shall be 5-inch depth hot dipped roll formed of 16 gage galvanized steel.

C. Blades: 6- inch width hot dipped, roll formed galvanized steel.

D. Axles: 1/2 inch nominal hexagonal zinc plated steel/

E. Bearings: High impact, molded synthetic formed to hexagonal axle shape.

F. Blade seals: Vinyl coated polyester, fire resistant, mechanically fastened.

G. Jamb seals: 300 series stainless steel compression type.

H. Linkage: Plated steel assembly, located out of airstream.

I. Size to match intake louver.

J. Ruskin CD 36 or equal

2.9 DAMPER ACTUATORS

1 Damper actuator: Electric quarter turn two position spring return type. 120V. Capable of direct mounting to damper actuating shaft. Sized for 150 percent of required damper operating torque.

2 Belimo LF120-US, or equal.

2.10 DUCTWORK INSULATION

A. TYPE D-1: Flexible glass fiber, commercial grade, ASTM C1290, Type III, with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.

1 Thermal Conductivity: 0.25 at 75 degrees F.

2 Maximum Operating Temperature: 250 degrees F.

3 Density: 0.75 pound per cubic foot.

B. TYPE D-2: Rigid glass fiber, ASTM C612, Type IA or IB, with factory applied reinforced aluminum foil facing meeting ASTM C1136, Type II.

1 Thermal Conductivity: 0.23 at 75 degrees F.

2 Density: 3.0 pound per cubic foot.

2.11 FUEL OIL PIPING – ABOVEGROUND

A. Copper Tubing: ASTM B88, Type K**,** drawn, soft temper.

1 Joints: Brass flare type fittings.

B. Steel Pipe: ASTM A53, Schedule 40 black.

1 Fittings: ASME B16.3, malleable iron, black.

2 Joints: Threaded

C. Unions: Class 150, black malleable iron, threaded.

D. Gate Valves: MSS SP80, class 125, bronze body, bronze trim, threaded bonnet, non-rinsing stem, inside screw with back seating stem, wedge disk, threaded ends.

E. Check Valves: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N disc, threaded ends.

F. Pipe Hangers and Supports: Conform to NFPA 31, ASME 31.9, and MSS SP-89

G. Flexible Connectors: Corrugated stainless steel inner hose with single layer of stainless steel exterior braiding, minimum 9 inches long with threaded ends; for maximum working pressure 200 psig

PART 3 -- EXECUTION

3.1 GENERAL

A. Install in accordance with applicable codes and standards.

B. Fuel oil fired heater:

1 Install in accordance with NFPA 31 and manufacturer's installation instructions.

C. Circulation Fan

1 Install in accordance with manufacturer's installation instructions.

2 Provide mounting extension tube lengths to locate the fan at the height shown on the drawings.

D. Ductwork:

1 Install in accordance with SMACNA standards.

2 Hangers: Install hangers and supports within 12 inches of each elbow and within 12 inches of each branch intersection. Extend strap supports down both sides of ducts and turn under bottom at least one inch. Secure hanger to sides and bottom of ducts with sheet metal screws.

E. Ductwork Insulation:

1 Insulate exhaust ductwork within 3 feet of building exterior penetrations with 1 inch thickness Type D-1 insulation.

2 Insulate engine radiator plenum with 1 inch thickness Type D-2 insulation.

a Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.

b Secure insulation without vapor retarder with staples, tape, or wires.

c Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.

d Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.

F. Fuel piping:

1 Install in accordance with NFPA 31.

2 Route piping in orderly manner and to avoid interference with access to equipment.

3 Ream pipe and tube ends. Remove burrs.

4 Prepare piping connections to equipment with flanges or unions.

5 Support piping at code recommended spacing, with supports within 12 inches of horizontal elbows and flexible connections.

6 Install valves with stems upright or horizontal, not inverted.

7 Protect piping systems from entry of foreign materials by temporary covers, completing Sections of Work, and isolating parts of completed system.

3.2 FIELD QUALITY CONTROL

A. Pressure-test fuel oil piping according to NFPA 31.

END OF SECTION

SECTION 26 00 00 - ELECTRICAL WORK, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide electrical work, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to all sections in Division 26, except as indicated otherwise.

C. The WORK of this Section is required for operation of electrically-driven equipment provided under specifications in other Divisions. The CONTRACTOR's attention is directed to the requirement for proper coordination of the WORK of this Section with the WORK of equipment specifications, and the WORK of instrumentation sections.

D. Concrete, excavation, backfill, and steel reinforcement required for encasement, installation, or construction of the WORK of the various sections of Division 26 is included as a part of the WORK under the respective sections, including duct banks, manholes, handholes, equipment housekeeping pads, and light pole bases.

E. The CONTRACTOR shall coordinate with the OWNER, ENGINEER and the serving utility, Alaska Power and Telephone (AP&T), as necessary for all work to be done in modification of the existing electrical service. Work shall include but not be limited to:

1 Applying for the new electrical service in a timely manner to allow the utility time to perform their work.

2 Installing the new electrical service to the utility’s standards.

3 Requesting utility inspections

4 Coordinating service connections and disconnections – the intent is for the new electrical service to be installed and active prior to disconnecting and removing the existing service.

F. All required utility fees shall be paid for by the CONTRACTOR including connect/disconnect fees and new service charges. For bidding purposes assume utilities fees will total $5,000.00. Contract adjustment will be made based on actual charges.

1.2 REFERENCE STANDARDS

A. The WORK of this Section and all sections in Division 26 shall comply with the following, as applicable:

NEC (NFPA 70)	National Electrical Code
NETA	International Electrical Testing Association

NEMA 250 Enclosure for Electrical Equipment (1000 Volts Maximum)

B. All electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or other State of Alaska recognized testing laboratory.

C. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards, state building standards, and applicable local codes and regulations.

D. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 SIGNAGE

A. Local Disconnect Switches:

1 Each local disconnect switch for motors and equipment shall be legibly marked to indicate its purpose, unless the purpose is indicated by the location and arrangement.

B. Isolating Switches: Isolating switches not interlocked with an approved circuit interrupting device shall be provided with a sign warning against opening them under load.

1.4 PUBLIC UTILITIES REQUIREMENTS

A. The Public Electrical Utility associated with this project is Alaska Power & Telephone (AP&T). The CONTRACTOR shall coordinate all requirements with the Utility.

B. The CONTRACTOR shall contact the serving utility and verify compliance with requirements before construction. The CONTRACTOR shall coordinate schedules and payments for work by all utilities.

C. Electrical service shall be as indicated and be as required by the serving utility.

D. The CONTRACTOR shall verify and provide all service conduits, fittings, grounding devices, and all service wires not provided by the serving utility.

E. The CONTRACTOR shall verify with the utility the exact location of each service point and type of service, and shall pay all charges levied by the serving utilities as part of the WORK.

F. The OWNER will separately apply and pay for a fiber optic internet connection to be provided by AP&T. The CONTRACTOR shall coordinate with both the OWNER and AP&T to assist and schedule the installation of the fiber optic service. The CONTRACTOR shall verify and provide all fiber optic service conduits, fittings and grounding devices required, but not provided by the serving utility.

1.5 PERMITS AND INSPECTION

A. All electrical permits shall be obtained and inspection fees shall be paid by the CONTRACTOR.

B. The CONTRACTOR shall pay all electrical utility line extension, service upgrade, equipment, connection and turn-on service charges required by the utility company.

1.6 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 Submittals Procedure.

B. Shop Drawings: Include the following:

1 Complete material lists stating manufacturer and brand name of each item or class of material.

2 Shop Drawings for all grounding WORK not specifically indicated.

3 Front, side, rear elevations, and top views with dimensional data.

4 Location of conduit entrances and access plates.

5 Component data.

6 Connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers.

7 Method of anchoring, seismic requirements, weight.

8 Types of materials and finish.

9 Nameplates.

10 Temperature limitations, as applicable.

11 Voltage requirement, phase, and current, as applicable.

12 Front and rear access requirements.

13 Test reports.

14 Grounding requirements.

15 Catalog cuts of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material. Catalog data sheets shall be stamped to indicate the project name, applicable Section and paragraph; and shall be clearly marked to indicate exact model number, and options being provided.

C. Shop Drawings shall be custom prepared. Drawings or data indicating "optional" or "as required" equipment are not acceptable. Options not proposed shall be crossed out or deleted from Shop Drawings.

D. Materials and Equipment Schedules: The CONTRACTOR shall deliver to the ENGINEER within 30 days of the commencement date in the Notice to Proceed, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The

list shall include type, sizes, names of manufacturers, catalog numbers, and other such information required to identify the items.

E. Owner's Manuals: Complete information in accordance with Section 01 33 00.

F. Record Drawings: The CONTRACTOR shall show invert and top elevations and routing of all duct banks and concealed below-grade electrical installations. Record Drawings shall be prepared, be available to the ENGINEER, and be submitted according to Section 01 33 00.

1.7 AREA DESIGNATIONS

A. General:

1 Raceway system enclosures shall comply with Section 26 05 33 – Raceway and Boxes for Electrical Systems.

2 Electrical WORK specifically indicated in sections within any of the Specifications shall comply with those requirements.

3 Electrical WORK in above ground indoor non-process areas shall be NEMA 1.

4 Electrical WORK in damp or wet locations and process areas shall be NEMA 4X unless otherwise indicated.

5 Electrical WORK in below ground facilities and outdoors shall be NEMA 4X unless otherwise indicated.

6 Installations in hazardous locations shall conform strictly to the requirements of the Class, Group, and Division indicated.

B. Material Requirements:

1 NEMA 4X enclosures shall be stainless steel, Type 304 or 316.

1.8 TESTS

A. The CONTRACTOR shall be responsible for factory and field tests required by specifications in Division 26 and by the ENGINEER or authority having jurisdiction. The CONTRACTOR shall furnish necessary testing equipment and pay costs of tests, including all replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

B. Where test reports are indicated, proof of design test reports for mass-produced equipment shall be submitted with the Shop Drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be approved prior to shipment. Field test reports shall be submitted for review prior to Substantial Completion.

C. Equipment or material which fails a test shall be removed and replaced.

D. Cable Testing: Cables and conductors shall be tested in accordance with Section 26 05 19.

E. Test Ground Fault Interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.

F. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:

1 Visual and physical check of cables, circuit breakers, transformers and connections associated with each item of new and modified equipment.

2 Circuit breakers that have adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field-adjusted by a representative of the circuit breaker manufacturer. Setting shall be tabulated and proven for each circuit breaker in its installed position. Test results shall be certified by the person performing the tests and be transmitted to the ENGINEER.

G. Complete ground testing of grounding electrodes per requirements prior to operating the equipment.

H. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the ENGINEER and after process control devices have been adjusted as accurately as possible. It is intended that the CONTRACTOR will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.

I. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated through coordination with the Owner's System Integrator to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.

J. Motor operated valves shall be tested after having been phased and tested for correct motor rotation and after travel and torque limit switches have been adjusted by a representative of the valve manufacturer. Tests shall verify status indication, proper valve travel, and correct command control from local and remote devices.

1.9 DEMOLITION AND RELATED WORK

A. The CONTRACTOR shall perform electrical demolition WORK as indicated on the electrical drawings and in parts of this Specification Section. The CONTRACTOR is cautioned that demolition WORK may also be indicated on non-electrical drawings.

Coordinate electrical de-energization, disconnection, and removal with all trades and the overall sequence of construction.

B. Electrical requirements associated with removed equipment shall be:

1 Remove power, control and signal wiring as indicated.

2 Remove all abandoned exposed raceways.

3 Encased conduits shall be cut flush to the floor and be grouted.

4 Remove remote mounted starters, disconnect switches, circuit breakers, sensors, and transmitters

5 Remove panels, switchboards, transfer switch, etc.

6 Remove remote mounted status lights and switches where indicated on the electrical drawings, and blank off openings in existing panels with field-fabricated stainless steel plates. Plates shall be attached with stainless steel finish screws.

7 Remove control panels, concrete bases and posts for panels.

8 Remove pump cords, level sensors, level switches.

C. Where new lighting and receptacles are installed, old lighting, receptacles, switches, wiring, and conduits shall be removed.

D. Raceways to be reused or extended shall be terminated in a new junction box. The junction box shall have a NEMA rating in accordance with the area in which it is located and shall be sized as required.

E. Materials and equipment not indicated to be removed and returned to the OWNER shall, upon removal, become the CONTRACTOR's property and shall be disposed of off-site.

F. Material and equipment indicated to be relocated or reused shall be removed, relocated, and reinstalled with care to prevent damage thereto.

G. Materials indicated to be returned to the OWNER shall be placed in boxes with the contents clearly marked and be stored at a location determined by the ENGINEER.

H. Where MCCs or panelboards are indicated to have circuits removed and reconnected, the MCCs shall have a new engraved phenolic nameplate worded as indicated, and the panelboards shall have new typed schedules modified to indicate the revised circuits. Pencil or magic marker markings directly on the MCC or panelboard breaker are not permitted.

1.10 CONSTRUCTION SEQUENCING

A. Continuance of facility operation during demolition and construction is critical at this facility. Therefore, the CONTRACTOR shall carefully examine all work to be done in, on, or adjacent to existing equipment. Work shall be scheduled, subject to the OWNER's approval, to minimize required process or equipment shutdown time. The

CONTRACTOR shall submit a written request including sequence and duration of activities to be performed prior to any plant shutdown.

B. Temporary power and communications between existing facilities may be required. Temporary systems shall be in place and staged for switchover prior to disconnection of any active circuits.

C. All switching, safety tagging, etc., required for process or equipment shutdown or to isolate existing equipment shall be performed by the CONTRACTOR. In no case shall the CONTRACTOR begin any work in, on, or adjacent to existing equipment without written authorization by the plant supervisor and the ENGINEER. The CONTRACTOR shall remove the lock within 4 hours upon request of the OWNER, in an emergency, and if the equipment is operable.

D. The CONTRACTOR shall make all modifications or alterations to existing electrical facilities required to successfully install and integrate the new electrical equipment as indicated on the electrical drawings. Modifications to existing equipment, panels, or cabinets shall be made in a professional manner with all coatings repaired to match existing. The CONTRACTOR is responsible for ensuring all panels and equipment are UL-listed. The costs for modifications (including UL listing) to existing electrical facilities required for a complete and operating system shall be included in the CONTRACTOR's original Bid amount and no additional payment for this WORK will be authorized.

E. Extreme caution shall be exercised by the CONTRACTOR in digging trenches in order not to damage existing underground utilities. Cost of repairs of damages caused during construction shall be the CONTRACTOR's responsibility without any additional compensation from the OWNER.

F. The CONTRACTOR shall be responsible for identifying available existing circuit breakers in lighting panels for the intended use as required by the Drawings. The CONTRACTOR shall also be responsible for field-verifying the available space in panelboards to integrate new circuit breakers. Costs for this WORK shall be included in the CONTRACTOR's original Bid amount.

G. The CONTRACTOR is advised to visit the Site before submitting a Bid to better acquaint itself with the WORK of this Contract. Lack of knowledge will not be accepted as a reason for granting extra compensation to perform the WORK.

1.11 INSTALLATION OF NEW EQUIPMENT:

A. The CONTRACTOR will install and terminate the new panelboards, motor starters, control panels, wireways, cables, and instruments, etc. in accordance with the agreed schedule. The CONTRACTOR shall provide a list, daily, of the points that are ready for service as they are connected, calibrated, and tested. The CONTRACTOR shall only connect to equipment that is new or is out of service.

B. The recommended construction sequence is as follows:

1 Provide temporary power and communication provisions.

2 Install new switchboards, motor starters, control panels and instruments.

3 Install new raceways between switchboards, motor starters, instruments, and new control panel.

4 Install all new wiring as specified.

5 Remove all demolition items and make good all surfaces before applying appropriate surface finish and paint.

6 Complete wiring modifications to existing equipment.

7 Allowable down time requirements: The CONTRACTOR shall minimize the amount of time a facility is out of service. All outages shall be scheduled with the OWNER and ENGINEER a minimum of two (2) days prior to outage. Scheduled outages shall last no longer than two (2) hours.

8 The OWNER shall take beneficial occupancy of each facility as the WORK is signed off.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. Equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the WORK shall be products of the same manufacturer. Equipment and materials shall be of industrial grade standard of construction.

B. Where a NEMA enclosure type is indicated in a non-hazardous location, the CONTRACTOR shall utilize that type of enclosure, despite the fact that certain modifications, such as cutouts for control devices, may negate the NEMA rating.

C. On devices indicated to display dates, the year shall be displayed as 4 digits.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware:

1 Nuts, bolts, and washers shall be stainless steel when used with PVC-Coated raceway and boxes or stainless steel enclosures. Hot-dipped galvanized nuts, bolts and washers may be used with galvanized rigid conduit (GRC) and enclosures that are not constructed of stainless steel.

2 Threaded rods for trapeze supports shall be continuous-threaded, stainless steel, 3/8-inch diameter minimum, when used with PVC-coated raceway and boxes. Hot-dipped galvanized hardware may be used with GRC.

3 Strut for mounting of raceways and equipment shall be galvanized or stainless steel as required by the area classification. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be

utilized to prevent such corrosion. Strut shall be as manufactured by **Unistrut, B-Line,** or equal.

4 Anchors for attaching equipment to concrete walls, floors and ceilings shall be stainless steel expansion anchors, such as **"Rawl-Bolt," "Rawl-Stud"** or **"Lok-Bolt"** as manufactured by **Rawl**; similar by **Star**, or equal. Wood plugs shall not be used.

2.3 ELECTRICAL IDENTIFICATION

A. Nameplates: Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock, **Formica type ES-1**, or equal. Each shall be fastened securely, using fasteners of brass, cadmium-plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style, with no characters smaller than 1/8-inch in height.

B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be heat-shrink plastic tubing with machine printing. Lettering shall read from left to right and shall face toward the front of the panel.

PART 3 -- EXECUTION

3.1 GENERAL

A. Incidentals: The CONTRACTOR shall provide all materials and incidentals required for a complete and operable system, even if not required explicitly by the Specifications or the Drawings. Typical incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor-furnished equipment to connect with other equipment indicated in the Contract Documents.

B. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined by the CONTRACTOR in the field, based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations on the Drawings, however, shall be followed as closely as possible.

1 Where raceway development drawings, or "home runs," are shown, the CONTRACTOR shall route the raceways in accordance with the indicated installation requirements.

2 Conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve headroom and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms as indicated. Where the Drawings do not indicate exact locations, the ENGINEER shall determine such locations. If equipment is installed without instruction and must be moved, it shall be moved without additional cost to the OWNER. Lighting fixture locations shall be adjusted slightly to avoid obstructions and to minimize shadows.

3 Wherever raceways and wiring for lighting and receptacles are not indicated, it shall be the CONTRACTOR's responsibility to provide all lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations as indicated. Wiring shall be #12 AWG minimum, and conduits shall be 3/4-inch minimum. Where circuits are combined in the same raceway, the CONTRACTOR shall de-rate conductor ampacities in accordance with NEC requirements.

C. Workmanship: Materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the work. Installation shall be coordinated in the field with other trades to avoid interferences.

D. Protection of Equipment and Materials: The CONTRACTOR shall fully protect materials and equipment against damage from any cause. Materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry. The CONTRACTOR shall replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections, as part of the WORK.

E. Incoming utility power equipment shall be provided in conformance with the utility's requirements.

3.2 CORE DRILLING

A. The CONTRACTOR shall perform core drilling required for installation of raceways through concrete walls, floors and handholes. Locations of floor penetrations, as may be required, shall be based on field conditions. Verify all exact core drilling locations based on equipment actually furnished, as well as exact field placement. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the OWNER prior to any core drilling activities. Damage to any encased conduits, wiring, and piping shall be repaired as part of the WORK.

B. All penetrations required to extend raceways through concrete walls, roofs, and floors or masonry walls shall be core drilled.

3.3 EQUIPMENT ANCHORING

A. Floor supported, wall-, or ceiling-hung equipment and conductors shall be anchored in place by methods that will meet seismic requirements in the area where the project is located. Wall-mounted panels that weigh more than 500 pounds, or which are within 18 inches of the floor, shall be provided with fabricated steel (stainless steel in designated areas) support pedestals. If the supported equipment is a panel or cabinet enclosed within removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung from 4-inch stud walls and weighing more than 300 pounds shall have auxiliary floor supports.

B. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the WORK of this Contract. Such recommendations shall be submitted as Shop Drawings under Section 01 33 00.

C. Panels, raceways, and other equipment shall be anchored and supported for Seismic requirements.

3.4 EQUIPMENT IDENTIFICATION

A. General: Equipment and devices shall be identified as follows:

1 Nameplates shall be provided for all switchboards, panelboards, MCCs, control and instrumentation panels, starters, switches, and pushbutton stations. In addition to nameplates, control devices shall be equipped with standard collar-type legend plates.

2 Control devices within enclosures shall be identified as indicated. Identification shall be similar to the subparagraph above.

3 Equipment names and tag numbers, where indicated on the Drawings, shall be utilized on all nameplates.

4 The CONTRACTOR shall furnish typewritten circuit directories for panelboards; circuit directory shall accurately reflect the equipment connected to each circuit.

5 Generator transfer switches shall be labeled “Main” and “Generator” with ½” lettering.

3.5 CLEANING

A. Before final acceptance, the electrical WORK shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. Oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners cleaned out. Touch-up paint shall be applied to scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum-cleaned.

B. CONTRACTOR shall group, coil, and tie wrap all spare cables at the bottom of the Local Control Panels. The wires shall be grouped according to the device, control panel, or MCC section they originate from. Cable groups shall be tagged according to their point of origin.

C. All debris shall be removed from the void below the panels.

3.6 CONTROL PANEL WIRING

A. The CONTRACTOR shall ensure all panels are UL-listed upon completion of the WORK.

END OF SECTION

SECTION 26 05 05 - ELECTRIC MOTORS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall provide electric motors, accessories, and appurtenances complete and operable, in conformance with the specifications and the Contract Documents.

B. The provisions of this Section apply to constant torque AC squirrel cage induction motors throughout the Contract Documents, except as indicated otherwise.

C. The CONTRACTOR shall assign to the equipment supplier the responsibility to select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the ENGINEER. Such review will consider future availability of replacement parts and compatibility with driven equipment.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00.

B. Complete motor data shall be submitted. Motor data shall include:

1 Motor manufacturer.

2 Motor type or model and dimension drawing. Include motor weight.

3 Nominal horsepower.

4 NEMA design.

5 Enclosure.

6 Frame size.

7 Winding insulation class and temperature rise class.

8 Voltage, phase, and frequency ratings.

9 Service factor.

10 Full load current at rated horsepower for application voltage.

11 Full load speed.

12 Torque characteristics.

13 Guaranteed minimum full load efficiency. Also, nominal efficiencies at 1/2 and 3/4 load.

14 Type of thermal protection or overtemperature protection, if included.

15 Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable.

16 Bearing data. Include recommendation for lubricants of regreasable type bearings.

17 Power factor at 1/2, 3/4 and full load.

PART 2 -- PRODUCTS

2.1 DESIGN REQUIREMENTS

A. General: Electric motors shall comply with NEMA MG-1 - Motor and Generator.

B. NEMA Design: Electric motors shall be NEMA Design B unless otherwise indicated. In no case shall starting torque or breakdown torque be less than the value in NEMA MG 1. Motors shall be suitable for the indicated starting method.

C. Insulation: Three phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in NEMA MG 1-12.44. Motors shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dt as defined in NEMA MG 1-31.

D. Motors shall be totally enclosed, fan-cooled (TEFC) with a Service Factor of 1.15, unless otherwise indicated.

E. Motors in electrical hazardous locations shall be appropriately rated for the type of hazardous location.

2.2 ACCESSORY REQUIREMENTS

A. General: Motors shall have split-type cast metal conduit boxes.

B. Lifting Devices: Motors weighing 265 lb (120 Kg) or more shall have suitable lifting eyes for installation and removal.

C. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

D. Nameplate: Motors shall be fitted with permanent stainless steel nameplates indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40.

2.3 MOTOR THERMAL PROTECTION

A. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperature-actuated switch. Thermostats shall be provided with one normally closed contact for each phase. The thermostat switch point shall be pre-calibrated by the manufacturer.

2.4 MOTOR BEARINGS

A. Motors shall have bearings designed for 100,000 hours (coupled) L-10 life.

B. Motors that are indirectly coupled and are controlled by VFD's shall have provisions to limit bearing currents. Provisions shall as a minimum be AEGIS SGR Bearing Protection Ring or an approved substitute. Contractor shall submit provisions, including means of installation, for approval.

2.5 MANUFACTURERS

A. U.S. Motors, Reliance Electric, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.

B. Motors shall be installed as required by the existing field conditions, including coupling and shims.

C. Related electrical WORK involving connections, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 26.

3.2 FIELD TESTING

A. The CONTRACTOR shall perform the following field tests:

1 Inspect each motor installation for any deviation from rated voltage, phase, frequency, and improper installation.

2 Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.

3 Check winding and bearing temperature detectors and space heaters for functional operation.

4 Test for proper rotation prior to connection to the driven equipment.

5 Test insulation (megger test) of new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION

SECTION 26 05 19 - WIRE AND CABLES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide wires and cable, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit Shop Drawings in accordance with Section 01 33 00 and 26 00 00 – Electrical Work, General.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Conductors, including grounding conductors, shall be copper. Aluminum conductor wire and cable will not be permitted. Insulation shall bear the label of Underwriters' Laboratories, Inc. (UL), the manufacturer's trademark, and identify the type, voltage, and conductor size. All conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment, such as motors and controllers, shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.

2.2 LOW VOLTAGE WIRE AND CABLE

A. Power and Lighting Wire

1 Power and lighting wire shall be No. 12 copper AWG minimum size.

2 Wire rated for 600 volts in duct or conduit for all power shall be:

a In above grade interior locations: Class B Type THWN-2

b In exterior, underground and below grade installations XHHW-2

3 Wiring for 600 volt class power and lighting shall be as manufactured by **General Cable**, **Okonite**, or **Rome Cable**.

B. Control Wire

1 Control wire in duct or conduit shall be the same type as power and lighting wire indicated above.

2 Control wiring shall be No.14, 19-strand copper AWG.

C. Instrumentation Cable

1 Instrumentation cable shall be rated at 600 volts.

2 Individual conductors shall be No. 18 AWG stranded, tinned copper. Insulation shall be color-coded polyethylene: black-red for two-conductor cable, and black-red-white for three-conductor cable.

3 Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 18 AWG stranded, tinned copper drain wire, and a PVC outer jacket with a thickness of 0.048-inches.

4 Single pair, No. 18 AWG, twisted, shielded cable shall be **Belden Part No. 9341**, or equal.

5 Single triad, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 1119A**, or equal.

D. Multi-pair Control Cable – Multi-pair control cable shall be 6-pair, 600V, No. 16 AWG, twisted, shielded, direct burial rated **Belden Part No. 1040A**, or equal.

E. Cat 6 Cable: Cat 6 patch cable shall be 4-pair 24-gauge twisted pair rated to TIA/EIA 568-C.2 Category 6 and UL-listed. The CONTRACTOR shall install RJ-45 connectors as required.

2.3 CABLE TERMINATIONS

A. Pre-insulated, pressure type, twist-on connectors for conductors #10 AWG and smaller shall be 3M Company "Scotchlok" or Ideal Industries, Inc. "Super Nut" or equal.

B. Compression connectors shall be **Burndy "Hi Lug", Thomas & Betts "Sta-Kon,"** or equal. Threaded connectors shall be split bolt type of high strength copper alloy.

C. Pre-insulated fork tongue lugs shall be **Thomas & Betts, Burndy**, or equal.

D. General purpose insulating tape shall be **Scotch No. 33, Plymouth "Slip-knot,"** or equal. High temperature tape shall be polyvinyl as manufactured by **Plymouth, 3M**, or equal.

E. Labels for coding 600-volt wiring shall be heat-shrink plastic tubing type with machine print. Lettering shall read from left to right and face the front of the panel. Field wires terminating at a Control Panel shall be labeled with the wire number shown on the Control Panel wiring diagrams. The CONTRACTOR shall mark all as-built drawings with wire labels.

PART 3 -- EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall provide and terminate all power, control, and instrumentation conductors, except where indicated.

3.2 INSTALLATION

A. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 2 percent at the farthest point of power distribution, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

B. Conductors for branch circuits as defined in Article 100 of the NEC, shall be sized to prevent a voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

C. Conductors shall not be pulled into raceway until raceway has been cleared of moisture and debris.

D. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL-approved for the cables/wires being pulled.

E. The following wiring shall be run in separate raceways:

1 24 VDC discrete signal and instrument power supply.

2 4-20 mA analog signal.

3 All AC circuits.

4 Intrinsically safe circuits.

F. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps and shall be fanned out to terminals.

G. Conduit Seals: Conduit penetrating building exterior walls shall be sealed with duct seal at the end of the conduit where the conduit enters the building. Provide cloth rag backing and 1” of duct seal so duct seal can be removed in the future.

3.3 SPLICES AND TERMINATIONS

A. General

1 No splicing or taps will be permitted in either feeder or branch circuits except at outlet or accessible junction boxes. Utilize compression type solderless connectors

when making splices or taps in conductors # 8 AWG or larger. Utilize pre-insulated connectors, 3M Company "Scotchlok" or Ideal Industries, Inc. "Super Nut" for splices and taps in conductors # 10 AWG and smaller. Tape all splices and joints with Scotch #88 plastic tape to secure insulation strength equal to that of the conductors joined.

2 There shall be no cable splices in underground conduits, manholes or pullboxes.

3 Stranded conductors shall be terminated directly on equipment box lugs, making sure that all conductor strands are confined within the lug. Use forked-tongue lugs where equipment box lugs have not been provided.

4 Excess control and instrumentation wire shall be properly taped and terminated as spares.

B. Control Wire and Cable

1 Control conductors shall be spliced or terminated only on terminal strips in panels or vendor-furnished equipment.

2 In terminal cabinets, junction boxes, motor control centers, and control panels, control wire and spare wire shall be terminated to terminal strips.

C. Instrumentation Wire and Cable

1 Shielded instrumentation cables shall be grounded at one end only, the receiving end (i.e., in the control panel) on a 4-20 mA system.

D. Power Wire and Cable

1 No 120/208-volt, 120/240-volt, and 480/277-volt branch circuit conductors may be spliced unless the CONTRACTOR can convince the ENGINEER that they are essential and the ENGINEER gives written permission.

3.4 CABLE IDENTIFICATION

A. General: Wires and cables shall be identified for proper control of circuits and equipment and to reduce maintenance effort.

B. Identification Numbers: The CONTRACTOR shall assign to each control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to all conductors having common terminals and shall be shown on "as built" drawings. Identification numbers shall appear within 3 inches of conductor terminals. "Control Conductor" shall be defined as any conductor used for alarm, annunciator, or signal purposes.

1 Multiconductor cable:

a Assign a number that shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath freestanding equipment.

b Cable number shall form a part of the individual wire number.

c Individual control conductors and instrumentation cable shall be identified at pull points as described above.

d The instrumentation cable numbers shall incorporate the loop numbers assigned in the Contract Documents.

2 All 120/208-volt system feeder cables and branch circuit conductors shall be color-coded as follows:

a Phase A - Black

b Phase B - Red

c Phase C - Blue

d Neutral - White

3 The 120/240-volt system conductors shall be color-coded as follows:

a Line 1 - Black

b Line 2 - Red

c Neutral - White

4 The 480/277-volt system conductors shall be color-coded as follows:

a Phase A - Brown

b Phase B - Orange

c Phase C - Yellow

d Neutral - Gray

5 Color-coding tape shall be used where colored insulation is not available.

a Branch circuit switch shall be Yellow.

b Insulated ground wire shall be Green.

c Neutral shall be White or Gray as indicated above.

6 Color coding and phasing shall be consistent throughout the Site, bus bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.

7 General purpose AC control cables shall be Red.

8 General purpose DC control cables shall be Blue.

9 Spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.

10 Terminal strips shall be identified by computer-printable, cloth, self-sticking marker strips attached under the terminal strip.

3.5 TESTING

A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-68-516 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. Factory test results shall be submitted in accordance with Section 013000 – Contractor Submittals, prior to shipment of cable. The following field tests shall be the minimum requirements:

1 Power cable rated at 600 volts shall be tested with a 1000-volt megohm meter for insulation resistance between phases and from each phase to a ground using a megohmeter. Tests shall be performed on all feeders as well as branch circuits serving motors or major pieces of equipment.

2 Field testing shall be done after cables are installed in the raceways.

3 Field tests shall be performed by a certified test organization acceptable to the cable manufacturer. Test results shall be submitted to the ENGINEER for review and acceptance.

4 Cables showing less than 100 megohm resistance shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

B. Continuity Test: Control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing all wires and cables in service.

END OF SECTION

SECTION 26 05 26 - GROUNDING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide the electrical grounding system, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 26 00 00 – Electrical Work, General apply to this Section.

C. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 and Section 26 00 00 – Electrical Work, General.

B. Shop Drawings: Manufacturer's product information for connections, clamps, and grounding system components, showing compliance with the requirements of this Section.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Components of the grounding electrode system shall be manufactured in accordance with ANSI/UL 467 - Standard for Safety Grounding and Bonding Equipment, and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

2.2 GROUNDING SYSTEM

A. Grounding loop conductors shall be bare annealed copper conductors suitable for direct burial. Conductors shall be No. 2/0 for 100A services, or No. 4/0 for all other service sizes, unless indicated otherwise.

B. Ground Rods

1 Unless indicated otherwise, ground rods shall be a minimum of 3/4-inch in diameter, 10 feet long, and have a uniform covering of electrolytic copper metallically bonded to a rigid steel core. The copper to steel bond shall be corrosion resistant.

2 Conform to ANSI/UL 467.

3 Sectional type joined by threaded copper alloy couplings.

C. Buried cable-to-cable and cable-to-ground rod connections shall be made using exothermic welds by **Cadweld, Enrico Products**, or equal.

D. Exposed grounding connectors shall be of the compression type (connector to cable), made of high copper alloy, and be manufactured specifically for the particular grounding application. The connectors shall be **Burndy, O.Z. Gedney**, or equal.

E. Grounding clamps shall be used to bond each separately derived system to the grounding electrode conductors.

F. Equipment Grounding Circuit Conductors

1 These conductors shall be the same type and insulation as the load circuit conductors. The minimum size shall be as outlined in Table 250.122 of the National Electrical Code, unless indicated otherwise.

2 Metallic conduit systems shall have equipment grounding wires as well as being equipment grounding conductors themselves.

G. Ground clamps in concrete shall be rated for use with rebar and embedded in concrete.

H. Manufacturers of grounding materials shall be **Copperweld, Blackburn, Burndy**, or equal.

PART 3 -- EXECUTION

3.1 GROUNDING

A. Provide a separate grounding conductor, securely grounded in each raceway independent of raceway material.

B. Provide a separate grounding conductor for each motor and connect at motor box. Do not use bolts securing motor box to frame or cover for grounding connectors.

C. Size in accordance with the NEC-Article 250 and local amendments.

D. Route conductors inside raceway.

E. Provide a green insulated wire as grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

F. Provide a separate grounding conductor in each individual raceway for parallel feeders.

G. Bond metallic cold water pipe systems and metallic building structure per NEC. Bond ALL metallic water pipe penetrations.

H. Measure ground impedance in accordance with IEEE STD 81 after installation but before connecting the electrode to the remaining grounding system.

I. Low Voltage Grounded System (600-volt or less): A low voltage grounded system is a system where the local power supply is a transformer with the transformer secondary grounded.

1 Grounding system connections for a premises wired system supplied by a grounded AC service shall have a grounding electrode connector connected to the grounded service conductor at each service, in accordance with the NEC.

2 The grounded circuit conductor shall not be used for grounding non-current carrying parts of equipment, raceways, and other enclosures except where specifically listed and permitted by the NEC.

J. Embedded Ground Connections

1 Underground and grounding connections embedded in concrete shall be UL listed compression type ground grid connectors.

2 The connection shall be made in accordance with the manufacturer's instructions.

3 The CONTRACTOR shall not conceal or cover any ground connections until the ENGINEER or authorized representative has established that every grounding connection conforms to the Contract Documents and has given the CONTRACTOR written confirmation.

K. Ground Rods

1 Locations shall be as determined in the field.

2 Rods forming an individual ground array shall be equal in length.

3 Rod spacing shall be a minimum of the rod length.

L. Shield Grounding

1 Shielded instrumentation cable shall have its shield grounded at one end only unless Shop Drawings indicate the shield will be grounded at both ends.

2 The grounding point shall be at the control panel or otherwise at the receiving end of the signal carried by the cable.

3 Termination of shield drain wire shall be on its own terminal screw.

4 Terminal screws shall be jumpered together using manufactured terminal block jumpers.

5 Connection to the ground bus shall be via a minimum green No. 12 conductor to the main ground bus for the panel.

END OF SECTION

SECTION 26 05 33 - ELECTRICAL RACEWAY SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide electrical raceway systems, complete and in place, in accordance with the Contract Documents.

B. In addition to NEC requirements provide an equipment grounding conductor run with or enclosing the circuit conductors in all raceways. The equipment grounding conductor shall be one or more or a combination of the following:

1 A copper, or copper-clad aluminum conductor.

2 This conductor shall be solid or stranded; insulated, covered, or bare; and in the form of a wire or a bus bar of any shape.

1.2 DEFINITIONS

A. Raceway System – raceway system consists of conduits, wireways, fittings, junction and pull boxes, supports and labels complete and ready for conductors.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Conduits, wireways, fittings, supports, labels, junction and pull boxes, and other indicated enclosures which are dedicated to the raceway system, shall comply with the requirements of this Section.

2.2 CONDUIT

A. Galvanized Rigid Steel Conduit (GRC)

1 Rigid steel conduit shall be mild steel, hot-dip galvanized inside and out.

2 Rigid steel conduit shall be manufactured in accordance with ANSI C80.1 - Rigid Steel Conduit, Zinc Coated, and UL-6.

3 Manufacturers, or Equal

4 LTV Steel;

5 Triangle;

6 Wheatland Tube.

7 GRC shall be used in damp, wet or exterior exposed locations and in process areas.

B. PVC-Coated Galvanized Rigid Steel Conduit (PVC-coated GRC)

1 The conduit, prior to PVC coating, shall meet the requirements for GRC conduit above.

2 A PVC coating shall be bonded to the outer surface of the galvanized conduit. The bond between the coating and the conduit surface shall be greater than the tensile strength of the coating.

3 PVC coating thickness shall be not less than 40 mils.

4 PVC-coated GRC shall be manufactured in accordance with the following standards:

5 UL-6

6 ANSI C80.1

7 NEMA RN1 - PVC Externally Coated Galvanized Rigid Steel Conduit, Intermediate Metal Conduit, and where shown on the plans

8 Manufacturers, or Equal

9 Robroy;

10 Ocal.

11 PVC-coated GRC shall be used underground, in the chlorine room and any other corrosive locations.

C. Liquidtight Flexible Conduit (LFMC)

1 Liquidtight flexible conduit (LFMC) shall be constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket.

2 LFMC shall be manufactured in accordance with UL-360 - Steel Conduits, Liquid-Tight Flexible.

3 Manufacturers, or Equal

4 Anaconda, "Sealtite";

5 Electriflex, "Liquatite".

D. Electrical Metallic Tubing (EMT)

1 Electrical metallic tubing shall be mild steel, hot-dip galvanized tubing complying with ANSI C80.3 and Fed.Spec. WWC-563 and shall be UL listed.

2 Elbows, bends, and fittings shall be made from full weight materials complying with the above and shall be coated the same as electrical metallic tubing.

3 EMT connectors and couplings shall be compression type with insulated throat. Set screw type not allowed. Fittings shall comply with UL514B.

4 Electrical metallic tubing shall be 3/4-inch trade size or larger and shall be manufactured by Allied Tube and Conduit Corp., Triangle PWC, Inc., or approved equal.

5 EMT conduit may be used in dry interior, non-process locations only including the generator room.

2.3 FITTINGS AND BOXES

A. General:

1 Fittings and boxes shall follow the conduit type of which they are installed with: PVC-Coated Fittings and Boxes or stainless steel boxes shall be used with PVC-Coated GRC; galvanized malleable iron Fittings and Boxes shall be used with GRC. Pressed or stamped steel boxes shall be used with EMT.

2 Cast and malleable iron fittings for use with metallic conduit shall be the threaded type with 5 full threads.

3 Fittings and boxes shall have neoprene gaskets and non-magnetic stainless steel screws. All covers shall be attached by means of holes tapped into the body of the fitting. Covers for fittings attached by means of clips or clamps will not be acceptable.

4 Non-explosion-proof boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.

5 Boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.

6 In outdoor areas, raceways shall be terminated in raintight hubs as manufactured by **Myers, O.Z. Gedney**, or equal. In other than outdoor areas, sealed locknuts and bushings shall be used.

7 Fittings and boxes in hazardous locations shall be suitable for the Class and Division indicated or required by code.

B. Cast Aluminum Fittings and Boxes

1 Cast aluminum boxes and fittings shall have less than 0.40 percent copper content.

2 Manufacturers, or Equal

3 O.Z. Gedney;

4 Appleton;

5 Crouse-Hinds.

C. Malleable Iron Fittings and Boxes

1 Fittings and boxes for use with galvanized steel conduit shall be of malleable iron or gray-iron alloy with zinc plating with same finish as the conduit.

2 Manufacturers, or Equal

3 O.Z. Gedney;

4 Crouse-Hinds;

5 Appleton.

D. PVC-Coated Fittings and Boxes

1 Fittings and boxes for use with PVC-coated GRC shall be PVC-coated and shall be products of the same manufacturer as the conduit.

2 Fittings used for LFMC and PVC-coated systems are to be PVC-coated.

E. Stainless Steel Boxes

1 Stainless steel boxes shall be used with PVC-coated GRC raceway systems and where indicated on the Drawings.

2 Stainless steel boxes shall be NEMA 4X, Type 304.

3 Stainless steel shall be a minimum 14-gauge thickness, with a brushed finish.

4 Doors shall have full-length stainless steel piano hinges. Non-hinged boxes are not acceptable.

5 Manufacturers, or Equal

6 Hoffman;

7 Rohn;

8 Hammond.

2.4 CABLE TRAYS

A. Cable trays are not to be used.

PART 3 -- EXECUTION

3.1 GENERAL

A. All wiring shall be run in raceway unless indicated otherwise.

B. Raceways shall be installed between equipment as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and

offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for this purpose. Field bends are required on conduits up to 2". Factory elbows may be utilized on raceways over 2". All fittings and connections shall be made tight.

C. Separate raceway systems shall be provided for:

1 Analog signals

2 24 VDC discrete signals and instrument power supply conductors

3 120 VAC and higher wiring

4 Intrinsically safe wiring

D. When non-loop powered instruments have only one raceway port, the CONTRACTOR may run both the analog and 24 VDC wiring in a short length of ½" LFMC to a splitter box where the wiring must then be separated into the required raceway system. The length of LFMC must be kept to the absolute minimum and must not exceed 3 feet unless written approval has been given by the ENGINEER.

E. Where raceway routings are indicated on plan views, follow those routings to the extent possible.

F. Routings shall be adjusted to avoid obstructions. Coordinate between trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation, and removal and re-installation to resolve conflicts shall be by the CONTRACTOR as part of the WORK.

G. Support rod attachment for ceiling-hung trapeze installations shall meet the seismic requirements.

H. Exposed raceways shall be installed parallel or perpendicular to structural beams.

I. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.

J. Exposed raceways shall be installed at least 1/2-inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, exposed raceways shall be installed 1/4-inch minimum from the face of walls or ceilings by the use of clamp backs or struts.

K. In underground facilities or NEMA 4X areas, all raceway penetrations in panels shall be bottom entry.

L. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, suitable insulating means shall be provided to prevent such corrosion.

M. To facilitate future expansion, boxes and fittings are to be installed when indicated on the drawings. Unused hubs are to be plugged with proprietary devices. Raceways that include future expansion provision are to be sized to accommodate any such specified wiring without exceeding the requirements of this specification.

N. The maximum allowable conduit fill for instrumentation and control wiring is given by the following table:

Conduit Diameter	No. of 14-Gauge Wires	No. of 18-Gauge TWS
3/4”	8	2
1”	16	4
1-1/4”	32	7
1-1/2”	48	10
2”	72	17

O. Note: No instrumentation or control wiring conduit is to be larger than 2 inches in diameter.

3.2 RACEWAYS

A. Exposed raceway systems shall be of the type specified for the area installed as identified herein.

B. Raceways concealed, or encased in concrete shall be PVC-coated GRC. Conduit shall emerge from the concrete perpendicular to the surface whenever possible.

C. Exposed conduit shall be 3/4-inch minimum trade size. Supports shall be installed at distances required by the NEC.

D. Conduit shall not be encased in the bottom floor slab below grade.

E. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4-inch for concrete not exposed to weather or in contact with the ground.

F. Raceways passing through a slab, wall, or beam shall not impair significantly the strength of the construction.

G. Raceways embedded within a slab, wall, or beam (other than those merely passing through) shall satisfy the following:

1 Conduits with their fittings embedded within a column shall not displace more than 4 percent of the gross area of cross section.

2 Conduits shall not be larger in outside dimension than one third the overall thickness of slab, wall, or beam in which embedded.

3 Raceways shall not be spaced closer than 3 outside diameters on centers.

H. Raceways shall be placed so that cutting, bending, or displacing reinforcement from its proper location will not be required.

I. Threads shall be coated with a conductive lubricant before assembly.

J. Joints shall be tight, thoroughly grounded, secure, and free of obstructions in the pipe. Conduit shall be adequately reamed to prevent damage to the wires and cables inside. Strap wrenches and vises shall be used to install conduit to prevent wrench marks on conduit. Conduit with wrench marks shall be replaced.

K. Wherever raceways enter substructures below grade, the raceways shall be sloped to drain water away from the structure. Extreme care shall be taken to avoid pockets or depressions in raceways.

L. Connections to motors and other equipment subject to vibration shall be made with LFMC not exceeding 3-feet in length. Equipment subject to vibration that is normally provided with wiring leads shall be provided with a cast junction box for the make-up of connections. The junction box is to be independently supported and not left free to hang from the equipment.

M. Raceways passing through walls or floors shall have plastic sleeves. Core drilling shall be performed in accordance with Section 26 00 00.

N. Conduit, fittings, and boxes required in hazardous classified areas shall be suitably rated for the area and shall be provided in strict accordance with NEC requirements.

O. Empty raceways shall be tagged at both ends to indicate the final destination. Where it is not possible to tag the raceway, destination shall be identified by a durable marking on an adjacent surface. A pull-cord shall also be installed in each empty conduit. This shall apply to conduits in floors, panels, manholes, equipment, etc.

P. Where an underground raceway enters a structure through a concrete roof or a membrane waterproofed wall or floor, core-drill the entrance and provide a Link-Seal, or equal, sealing device. The sealing device shall be utilized with PVC-coated GRC/rigid steel conduit.

Q. Final connections to heaters, instruments, motors, limit switches, and any equipment subject to vibration shall be made with LFMC and approved fittings. Maximum length of LFMC shall be 3 feet.

R. Connections to solenoid valves, pilot actuators, and flood sensors shall be made with LFMC and approved fittings to a cast box with screw cover (GUA type), independently and securely supported. In no case is the device to support the cast box.

3.3 CABLE TRAYS

A. Cable trays are not to be used.

END OF SECTION

SECTION 26 05 43 - UNDERGROUND RACEWAY SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide underground raceway systems, including trenching, backfill, compaction, and restoration, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00, and 26 00 00 – Electrical General Requirements.

B. Shop Drawings

1 Complete catalog cuts of all conduit and fittings marked where applicable to show proposed materials and finishes.

C. Record Drawings

1 Show routings, burial depths, locations and sizes.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Fittings that are dedicated to the underground raceway system shall comply with the requirements of this Section.

2.2 UNDERGROUND CONDUITS

A. Underground raceways shall be:

1 Schedule 40 HDPE. HDPE for buried horizontal runs shall be UL-Listed, compliant with NEC articles 300 and 353 and listed to UL 651 A&B and NEMA TC-7.

or

2 PVC-Coated GRC meeting the requirements of 26 05 33.

B. Identification Tape: Continuous lengths of underground warning tapes shall be installed a minimum of 12-inches above and parallel to conduits. Tape shall be 6-inches wide polyethylene film imprinted "CAUTION - ELECTRIC UTILITIES BELOW." Tape shall have non-ferrous metal foil conductor sandwiched in the tape for detection purposes. Tape shall be as manufactured by **Brady**, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Underground raceways shall be installed between structures as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be fabricated with tools designed for this purpose. Factory elbows shall be utilized wherever possible. Unless otherwise noted provide PVC-Coated GRC for vertical sweeps and risers.

B. Raceway routing shall be adjusted to avoid obstructions.

3.2 INSTALLATION

A. Raceways shall be installed in accordance with the criteria below:

1 Raceway shall be laid on a grade line of at least 3-inches per 100-feet, sloping towards handholes or structures. Conduit shall be installed and handhole depths adjusted so that the top of the conduit is a minimum of 24-inches below grade and a minimum of 24-inches below roadways, driveways, and bike trails.

2 Changes in direction of the duct envelope by more than 10 degrees horizontally or vertically shall be accomplished using factory elbows.

3 Raceway shall be installed in accordance with the Manufacturer's requirements and recommendations. The bottom of trench shall be of select backfill or sand.

4 Each of the completed raceways shall be cleaned by drawing through it a standard flexible mandrel one foot long and 1/4-inch smaller than the nominal size of the duct. After passing of the mandrel, a wire brush and swab shall be drawn through.

5 Provide Dura-line Shur-lok II, or approved equal, fittings when converting between different raceway materials (i.e.: HDPE to PVC-Coated GRC).

B. Raceway penetration through walls of structures and handholes below grade shall be watertight.

C. When raceway enters a building, conduit shall transition to rigid steel PVC-coated conduit on stub-up.

D. Where an underground raceway enters a structure through a concrete wall, provide a **Link-Seal**, or equal sealing device. The sealing device shall be utilized with plastic coated rigid steel conduit. Transition from HDPE to PVC-Coated GRC prior to building or handhole entry.

3.3 RESTORATION

A. The CONTRACTOR shall restore all disturbed areas.

B. Grassed areas shall be backfilled, compacted, and top-soiled and reseeded.

C. Gravel driveways shall be restored including backfill and compaction to 95 percent density to match existing.

END OF SECTION

SECTION 26 22 00 - DRY TYPE TRANSFORMERS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide dry-type transformers, complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. General: Submittals shall be in accordance with Section 01 33 00 and Section 26 00 00 – Electrical Work, General.

B. Shop Drawings

1 Transformers

2 Dimension drawings

3 Technical certification sheets

4 Drawing of conduit entry/exit locations

5 Transformer ratings, including:

a Voltage
b Continuous current
c Basic impulse level for equipment over 600 volts
d kVA

6 Descriptive bulletins

7 Product sheets

PART 2 -- PRODUCTS

2.1 GENERAL

A. Transformers

1 The transformers shall be dry-type, designed, manufactured, and tested in accordance with the latest applicable standards of ANSI and NEMA.

2 Transformers shall be UL-listed and bear the UL label.

2.2 TRANSFORMERS

A. Ratings

1 kVA and voltage ratings shall be as indicated.

2 Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96 - Guide for Loading Dry Type Distribution and Power Transformers

3 Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

a Up to 9 kVA 40 db
b 10 to 50 kVA 45 db
c 51 to 150 kVA 50 db

B. Construction

1 Insulation Systems

a Transformers shall be insulated as follows:

i 2 kVA and below: 150 degrees C insulation system based upon 80 degree C rise.
ii 3 to 15 kVA: 185 degrees C insulation system based upon 115 degrees C rise. 15 kVA and above: 220 degrees C insulation system based upon 150 degrees C rise.

b Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient.

c All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM D 635 – Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

2 Transformer windings shall be copper.

3 Transformers shall have four 2-1/2 percent taps, two above and two below 480 volts.

C. Manufacturers: Transformers shall be floor- or wall-mounted type by **General Electric, Cutler-Hammer, Square D**, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. All WORK of this Section shall be installed as indicated in Section 26 00 00 – Electrical Work, General.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide panelboards complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

C. Panelboards shall be provided with surge protection devices in accordance with Section 26 43 13 – Surge Protection for Low Voltage Electrical Power Circuits.

1.2 CONTRACTOR SUBMITTALS

A. General: Submittals shall be in accordance with Section 01 33 00 and Section 26 00 00 – Electrical Work, General.

B. Shop Drawings

1 Breaker layout drawings with dimensions and nameplate designations

2 Component list

3 Drawings of conduit entry/exit locations

4 Assembly ratings including:

a Short circuit rating
b Voltage
c Continuous current

5 Cable terminal sizes

6 Descriptive bulletins

7 Product sheets

8 Installation information

9 Seismic certification and equipment anchorage details

PART 2 -- PRODUCTS

2.1 PANELBOARDS

A. Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1-Panelboards, as well as the provisions of UL 50 – Safety Enclosures for Electrical Equipment and UL 67 – Safety Panelboards. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-volt, 3-phase operation or 120/240-volt for single phase operation as indicated. Power panelboards shall be rated for 480 volts, 3-phase, 3-wire operation.

B. The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers.

C. Ratings

1 Panelboards rated 240 VAC or less shall have short circuit ratings not less than 10,000 amps RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.

2 Panelboards rated 480 VAC shall have short circuit ratings not less than 18,000 amps RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.

3 Panelboards shall be labeled with a UL short circuit rating. Series ratings are not acceptable.

4 Service entrance panelboards (panels connected to transfer switches or power meters) rated 240 VAC or less shall have short-circuit rating not less than 22,000 amps RMS symmetrical.

D. Construction

1 All lighting and power distribution panels shall have copper bus bars.

2 Breakers shall be one, two, or three pole as indicated, with ampere trip ratings as required by the equipment. Breakers shall be quick-make and quick-break, inverse time trip characteristics, to trip free on overload or short circuit, and to indicate trip condition by the handle position.

3 The panels shall have hinged doors with combination catch and latch. The front panels shall be so arranged that when the plates are removed, the gutters, terminals and wiring will be exposed and accessible. The doors shall have inner doors within the plates to have only the breaker operating mechanism exposed when they are opened. Live conductors and terminals shall be concealed behind the plates.

4 All panelboards shall be rated for the intended voltage.

5 All circuit breakers shall be interchangeable and capable of being operated in any position as well as being removable from the front of the panelboard without disturbing adjacent units.

6 Circuit breakers shall be the bolt-on type. No plug-in circuit breakers will be acceptable.

7 Lighting and power distribution panels which are not part of a motor control center shall be constructed in accordance with Section 26 00 00 – Electrical Work, General. Panels shall have the necessary barriers, supports, and liberal wiring gutters. Trim screws shall be stainless steel. All panelboard parts of metal other than copper, aluminum, or stainless steel shall be cadmium plated. Panelboards shall be as manufactured by **Allen-Bradley, General Electric,** or **Cutler-Hammer**.

8 Panelboards shall be UL listed.

9 Panelboards shall be suitable for use as service entrance as indicated or as otherwise required by the NEC.

PART 3 -- EXECUTION

3.1 GENERAL

A. All WORK of this Section shall be installed as indicated in Section 26 00 00 – Electrical Work, General.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all wiring devices, plates, and nameplates in accordance with the Contract Documents.

B. The requirements of Section 26 00 00 – Electrical General Requirements apply to this Section.

C. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00.

B. Shop Drawings

1 Complete catalog cuts of switches, receptacles, enclosures, covers, and appurtenances, marked to clearly identify proposed materials.

2 Documentation showing that proposed materials comply with the requirements of NEC and UL.

3 Documentation of the manufacturer's qualifications.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All devices shall carry the UL label.

B. General purpose duplex receptacles and toggle switch handles shall be brown everywhere except in finished rooms where they shall be ivory. Special purpose receptacles shall have a body color as indicated. Receptacles and switches shall conform to Federal Specifications W-C-596E and W-S-896E, respectively.

2.2 LIGHTING SWITCHES

A. Local branch switches shall be toggle type, rated at 20 amps, 120-277 VAC, and shall be **General Electric Cat. No. GE-5951-1** for single pole, **GE-5953-1** for 3-way and **GE-5954-1** for 4-way, or similar types as manufactured by **Hubbell**, or equal.

2.3 GENERAL PURPOSE RECEPTACLES

A. Duplex receptacles rated 120-volt, 20 amps shall be polarized 3-wire type for use with 3-wire cord with grounded lead and 1 designated stud shall be permanently grounded to the conduit system (NEMA 5-20R). Duplex 120-volt receptacles shall be **G.E. 5362, Hubbell 5362**, or equal. Simplex receptacles shall be **G.E. 4102, Hubbell 4102**, or equal.

B. Ground-fault circuit interrupting receptacles (GFCI's) shall be installed at the locations indicated. GFCI's shall be rated 125-volt, 20 amps and shall be **Hubbell GFTR20**, or equal. Downstream GFCI protection through the use of feed-thru receptacles is not acceptable.

C. Receptacles in exterior and wet locations shall be weather-resistant and marked accordingly.

2.4 ENCLOSURES AND COVERS

A. Surface mounted switches and receptacles shall be in FS or FD type cast device boxes.

B. In areas where cast boxes are used, switch and receptacle covers shall be **Crouse-Hinds Catalogue No. DS185 and WLRD-1, or Adalet No. WSL and WRD**, or equal.

C. Receptacles in exterior locations shall be provided with s-hinged cover/enclosure marked “Suitable for Wet Locations when in use” and “UL Listed.” There shall be a gasket between the enclosure and the mounting surface and between the hinged cover and mounting plate/base. The cover shall be **TayMac Specification Grade**, or equal, of metallic construction.

2.5 NAMEPLATES

A. Provide nameplates or equivalent markings on switch enclosures to indicate ON and OFF positions of each switch. ON and OFF for 3-way or 4-way switches is not acceptable. Provide receptacles for special purposes with nameplates indicating their use. Conform to requirements of Section 26 00 00 – Electrical Work, General.

PART 3 -- EXECUTION

3.1 CONNECTION

A. Securely fasten nameplates using stainless steel screws, bolts, or rivets centered under or on the device, unless otherwise indicated.

3.2 GROUNDING

A. Ground all devices, including switches and receptacles, in accordance with NEC Article 250 and Section 26 05 26 – Grounding.

B. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.

C. Ground flush receptacles and their metal plates through positive ground connections to outlet box and grounding system. Maintain ground to each receptacle by spring-loaded grounding contact to mounting screw or by grounding jumper, each making positive connection to outlet box and grounding system at all times.

3.3 FIELD TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 26 00 00 – Electrical Work General Requirements.

B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.

END OF SECTION

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 -- GENERAL

1.1 SUMMARY

A. This Section describes general requirements, products, and methods of execution relating to overcurrent protective devices approved for use on this project. Type, duty rating and characteristics, fault interrupting capability and coordination requirements shall be determined from the plans.

1.2 RELATED WORK

A. The work of the following Sections is related to the work of this Section. Other Sections, not referenced below, may also be related to this work. It is the Contractor's responsibility to perform all the work required by the Contract Documents.

1 Division 26 00 00 – Electrical General Requirements

1.3 SUBMITTALS

A. In accordance with the requirements of Section 01 33 00, submit the following Project Data:

1 Descriptive literature bulletins, and catalog cuts of the equipment.

2 Materials of construction.

3 Complete wiring diagrams.

4 Complete installation instructions, with points of electrical connection requirements clearly shown.

5 Performance curves.

1.4 QUALITY ASSURANCE

A. Devices shall be the latest approved design as manufactured by a nationally recognized manufacturer and in conformity with applicable standards and UL listed.

PART 2 -- PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKERS

A. Molded case circuit breakers shall be suitable for individual as well as panelboard mounting. They shall be bolt-on type, unless "plug-on" type specifically allowed.

B. The breakers shall meet NEMA and/or UL specifications as applicable to frame and size, standard rating and interrupting capability. Breakers installed in panelboards shall have short circuit interrupt ratings that match those of the panelboard.

C. The breakers shall be one-, two-, or three-pole as scheduled, operate manually for normal ON-OFF switching and automatically under overload and short circuit conditions.

D. Operating handle shall open and close all poles simultaneously on a multi-pole breaker. Operating mechanism shall be trip-free so that contacts cannot be held closed against abnormal overcurrent or short circuit condition.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Size devices as required by the load being served or as shown on the drawings.

END OF SECTION

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 -- GENERAL

1.1 SUMMARY

A. This Section describes general requirements, products, and methods of execution relating to manual and magnetic motor starters provided in this and other Divisions. Overloads shall be furnished and installed in Division 26.

1.2 RELATED WORK

A. The work of the following Sections is related to the work of this Section. Other Sections, not referenced below, may also be related to this work. It is the Contractor's responsibility to perform all the work required by the Contract Documents.

1 Division 23 – HVAC

2 Division 26 – Electrical

1.3 SUBMITTALS

A. In accordance with the requirements of Section 01 33 00, submit the following Project Data:

1 Descriptive literature bulletins, and catalog cuts of the equipment.

2 Materials of construction.

3 Complete wiring diagrams.

4 Complete installation instructions, with points of electrical and plumbing connection requirements clearly shown.

5 Complete Performance Data at the Design Point

6 Complete elementary wiring schematics showing all field connections to motors, control devices and PLC's. A separate schematic shall be provided specific to each motor and shall reference instrument, control device and/or PLC tags as shown on the drawings.

1.4 QUALITY ASSURANCE

A. Equipment shall be of the latest approved designs manufactured by a nationally recognized manufacturer and in conformity with the governing NEMA standards.

B. All electrical equipment and materials specified herein shall be listed by and shall bear the label of Underwriters Laboratories (UL), Factory Mutual (FM) or other nationally recognized testing laboratory acceptable to the State of Alaska Mechanical Inspections Division.

PART 2 -- PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S

A. Allen Bradley, Square D

B. Or equal

2.2 AC FRACTIONAL HORSEPOWER MANUAL STARTERS

A. The manual starter shall consist of a manually operated toggle switch equipped with melting alloy-type thermal overload relay.

B. Thermal unit shall be one-piece construction and interchangeable. Starters shall be inoperative if thermal unit is removed. Spare thermal elements shall be provided for all sizes used.

2.3 AC MANUAL STARTERS - LINE VOLTAGE TYPE

A. Manual starters shall be constructed and tested in accordance with the latest published NEMA standards.

B. The manual starters shall consist of a manually operated switch equipped with melting alloy type thermal overload relays in every phase conductor. The overload relays shall be trip-free and the starter shall be inoperative if any thermal unit is removed. Thermal units must be one-piece construction.

C. Starters shall be furnished in a NEMA 4X enclosure unless otherwise indicated on the plans or required by the conditions of the area in which they are installed.

2.4 AC MAGNETIC STARTERS - LINE VOLTAGE TYPE

A. Motor starters shall be across-the-line magnetic type rated in accordance with NEMA standards, sizes and horsepower ratings.

B. Starters shall be mounted individually in their own NEMA rated enclosures or group mounted in a Motor Control Center as shown on the drawings.

C. Starters shall be furnished with adjustable solid-state overload relay providing motor overcurrent protection, ground fault, jam/stall protection and phase loss.

D. Starters through NEMA size three shall be equipped with double break silver alloy contacts. All contacts shall be replaceable without removing power wiring or removing starter from panel.

E. Coils shall be of molded construction and shall be 120VAC.

F. Starters shall be suitable for the addition of at least four external electrical interlocks of any arrangement normally open or normally closed.

G. All starters shall have as a minimum, an enclosure mounted, “running” pilot light.

2.5 AC COMBINATION STARTERS WITH CIRCUIT BREAKER

A. Combination starters shall be manufactured in accordance with the latest published NEMA standards, sizes and horsepower ratings.

B. The disconnect handle used on combination starters shall always be in control of the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "on" or "off".

C. Starters shall be in accordance with Section 26 29 13, Paragraph 2.4 - AC MAGNETIC STARTERS - LINE VOLTAGE TYPE.

2.6 ACCESSORIES

A. Provide push buttons, selector switches, pilot lights, elapsed time meters, etc., as indicated on the drawings or as required herein and elsewhere in these specifications. Device shall be standard components normally supplied from the factory with the starters.

PART 3 -- EXECUTION

3.1 COORDINATION

A. Coordinate all details pertaining to the motor control equipment with the Division of these Specifications where the equipment is specified.

3.2 CONTROL WIRING

A. Control wiring and control devices shall be provided under the Specification Section in which the controlled equipment is specified.

3.3 NAMEPLATES

A. Provide nameplates for all starters. Coordinate names with mechanical equipment lists.

3.4 OVERLOAD PROTECTION

A. Install overload protection. Verify that protection corresponds to motor full load current and that motors starts and operates properly.

B. Provide Ambient Compensated or Ambient insensitive overload relays on all motor circuits that serve motors in remote locations.

3.5 CONTROL CIRCUITS

A. Install control circuits and perform continuity tests. Check control and interlock wiring for proper operation.

B. Where there are wires in the starter that are energized from an external source, a permanent warning sign shall be attached to the front and either a separate disconnect switch shall be installed in the starter or interlock contact(s) shall be provided on the starter disconnecting device to de-energize the externally supplied circuit inside the starter.

3.6 LABELS

A. When starter interlocks with other starters or controls, provide a label on the outside of the cover stating nature of interlock system.

END OF SECTION

SECTION 26 43 13 - SURGE PROTECTION FOR LOW VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 -- GENERAL

1.1 SUMMARY

A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for surge protection for low voltage electrical power circuits as required for the complete performance of the work, and as shown on the Drawings and as herein specified.

B. Section Includes: The work specified in this Section includes, but shall not be limited to, the following:

1 Requirements for integrated SPDs (installed from the factory) for low voltage power

1.2 REFERENCES

A. General: 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 edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1 ANSI/IEEE C62.41.1, “Guide on the Surges Environment in Low Voltage (1000 V and Less) AC Power Circuits.”

2 ANSI/IEEE C62.41.2, “Recommended Practice on Characterization of Surges in Low Voltage (1000 V and Less) AC Power Circuits.”

3 ANSI/IEEE C62.45, “Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits.”

C. International Organization for Standardization (ISO):

1 ISO 9001, "Quality Management Systems - Requirements."

D. National Fire Protection Association (NFPA):

1 NFPA 70, "National Electrical Code," hereinafter referred to as NEC.

E. Underwriters Laboratories, Inc. (UL):

1 UL 67, "Standard for Panelboards."

2 UL 1449, "Standard for Surge Protective Devices."

1.3 DEFINITIONS

A. $I_{(n)}$: Nominal discharge current rating.

B. MCOV: Maximum continuous operating voltage.

C. Protection Modes: The pair of electrical connections where the VPR applies.

D. MOV: Metal oxide varistor; an electronic component with a significant non-ohmic current voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 SYSTEM DESCRIPTION

A. General SPD Requirements:

1 SPD with accessories shall be listed and labeled as defined in NEC, by UL, and marked for intended location and application.

2 Comply with UL 1449.

3 Comply with UL 1283 (applies to Type 2 SPDs).

4 Design in accordance with ANSI/IEEE C62.41.1, ANSI/IEEE C62.41.2, and ANSI/IEEE C62.45.

5 SPDs manufacturer shall be ISO 9001 certified.

6 MCOV of the SPD shall not be less than 115 percent for 480Y/277V and 125 percent for 208Y/120V nominal RMS system voltages.

7 SPDs installed internal to the distribution equipment shall be of the same manufacturer as the equipment. The equipment shall be fully tested and certified to the following UL standards:

a. Panelboards: UL 67.

b. Motor Control Centers: UL 845.

c. Busway: UL 857.

d. Switchboards: UL 891.

1.5 SUBMITTALS

A. General: See Section 01 33 00 – Contractor Submittals.

B. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.

1 For each type of product indicated include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

2 Provide verification the SPD is listed or recognized through UL to the latest safety standard, UL 1449.

C. Shop Drawings: Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data.

D. Operation and Maintenance Data: Submit operation and maintenance data for surge protection for low voltage electrical power circuits to include in operation and maintenance manuals.

E. Warranty Data: Submit sample of special warranties.

1.6 QUALITY ASSURANCE

A. Qualifications:

1 Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of surge protection for low voltage electrical power circuits of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years.

2 Installer Qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing surge protection for low voltage electrical power circuits similar in type and scope to that required for this Project and shall be approved by the manufacturer.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

C. Single Source Responsibility: Obtain surge protection for low voltage electrical power circuits and required accessories from a single source with resources to produce products of consistent quality in appearance and physical properties without delaying the work. Any materials which are not produced by the manufacturer shall be acceptable to and approved by the manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.8 WARRANTY

A. Special Warranty: Submit a written warranty executed by the manufacturer, the Installer, and the Contractor, agreeing to repair or replace surge protection for low voltage electrical power circuits that fail in materials or workmanship within the specified warranty period.

1 Warranty Period: Warranty period shall be 10 years from date of Substantial Completion.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Product specified is "Surgelogic Surge Protection" as manufactured by Square D by Schneider Electric. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Engineer will be the sole judge of the basis of what is equivalent.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. SPDs: Comply with UL 1449.

1 SPDs installed on the line side of the service entrance OCPD shall be Type 1 SPDs. SPDs installed on the load side of the service entrance OCPD shall be either Type 1 or Type 2 SPDs.

2 Type 2 SPDs shall also comply with UL 1283.

B. Features and Accessories: SPDs shall provide the following features and accessories:

1 Internal fusing design capable of disconnecting the SPD before any damaging external effects to the suppressor or surroundings occur.

2 Indicator light(s) display for power and protection status with push-to-test capabilities.

3 Audible alarm with silencing switch.

4 Form C contacts; one normally open and one normally closed for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

5 Surge counter with reset switch.

6 Optional integral disconnect switch for externally mounted SPDs. SPDs integrated into factory supplied equipment shall have an input disconnect switch or circuit breaker unless indicated on the equipment drawings/data sheets.

C. Surge Current Rating: The surge current rating of the SPD shall be dependent of its category/location, as follows:

Category/Location	Application	Per Phase	Per Mode
C	Service Entrance	240 kA	120 kA
B	Distribution	160 kA	80 kA

D. Protection Modes:

1 UL 1449 VPR for grounded WYE configured circuits shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	800 volts	1200 volts	1500 volts
L-L	1200 volts	2000 volts	2500 volts

2 UL 1449 VPR for Delta configured circuits shall not exceed the following:

Modes	240D	480D	600D
L-G; N-G	1200 volts	2000 volts	2500 volts

E. SCCR: Per NEC 285.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point on the system where installed.

F. Nominal Discharge Current Rating: 20 kA $I_{(n)}$.

1 Surge protective devices located at service entrance locations shall carry a minimum nominal discharge current rating of 20 kA to meet the requirements of UL 96A.

2.3 DISTRIBUTION/ BRANCH PANEL SUPPRESSORS

A. SPDs: Comply with UL 1449.

1 Type 1 or Type 2 SPDs.

2 Type 2 SPDs shall also comply with UL 1283.

B. Features and Accessories: SPDs shall provide the following features and accessories:

1 Internal fusing design capable of disconnecting the SPD before any damaging external effects to the suppressor or surroundings occur.

2 Indicator light(s) display for power and protection status.

3 Audible alarm with silencing switch.

4 Form C contacts; one normally open and one normally closed for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

5 Surge counter with reset switch.

6 Optional integral disconnect switch for externally mounted SPDs. SPDs integrated into factory supplied equipment shall have an input disconnect switch or circuit breaker unless indicated on the equipment drawings/data sheets.

C. Surge Current Rating: The surge current rating of the SPD shall be dependent of its category/location, as follows:

Category/Location	Application	Per Phase	Per Mode
B	Distribution	160 kA	80 kA
B	Branch	120 kA	60 kA

D. Protection Modes:

1 UL 1449 VPR for grounded WYE configured circuits shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	800 volts	1200 volts	1500 volts
L-L	1200 volts	2000 volts	2500 volts

2 UL 1449 VPR for Delta configured circuits shall not exceed the following:

Modes	240D	480D	600D
L-G; N-G	1200 volts	2000 volts	2500 volts

E. SCCR: Per NEC 285.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point on the system where installed.

F. Nominal Discharge Current Rating: 10 kA $I_{(n)}$.

2.4 ENCLOSURES

A. Enclosure shall meet or exceed the ratings for the environment to be installed as indicated on drawings.

1 Indoor Enclosures for Externally Mounted SPDs: NEMA 250, Type 3R.

2 Outdoor Enclosures for Externally Mounted SPDs: NEMA 250, Type 3R, 4X.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

1 Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 INSTALLATION

A. Install surge protection for low voltage electrical power circuits in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.

B. Install SPD devices at the service entrance in accordance with NEC. SPDs installed on the line side of the service entrance OCPD shall be Type 1 SPDs. SPDs installed on the load side of the OCPD shall be either Type 1 or Type 2 SPDs.

C. Follow manufacturer's recommended installation practices.

1 Provide a minimum 30 ampere circuit breaker as a dedicated disconnecting means for the SPD unless otherwise indicated.

2 Install SPDs with properly rated conductors between suppressor and points of attachment as short and straight as possible; adjust circuit breaker positions to achieve shortest and straightest leads.

3 Do not splice and extend SPD leads unless specifically permitted by manufacturer.

4 Twist input conductors together to reduce the input inductance.

3.3 FIELD QUALITY CONTROL

A. See Section 01 45 00 - Quality Control.

B. Perform the following tests and inspections.

1 Compare equipment nameplate data for compliance with the Drawings and the Specifications.

2 Inspect anchorage, alignment, grounding, and clearances.

3 Verify that electrical wiring installation complies with manufacturer's written installation requirements.

C. An SPD will be considered defective if it does not pass inspections.

D. Prepare inspection reports.

3.4 DEMONSTRATION

A. Start-Up Service:

1 Complete start-up checks according to manufacturer's written instructions.

2 Do not perform insulation resistance tests of the distribution wiring equipment with SPDs installed. Disconnect all wires, including, but not limited to, neutral of the SPD before conducting insulation resistance tests, and reconnect them immediately after the testing is over.

3 Energize SPDs after power system has been energized, stabilized, and tested.

3.5 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to the Installer that shall ensure that the surge protection for low voltage electrical power circuits shall be without damage at time of Substantial Completion.

END OF SECTION

SECTION 26 50 00 - LIGHTING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide lighting fixtures, supports, and lamps, and accessories, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. If the CONTRACTOR proposes to install equivalent equipment to that suggested, then he shall furnish the following product information in accordance with Section 01 33 00.

1 Interior luminaires

a Catalog data sheets and pictures.

b Luminaire finish and metal gauge.

c Lens material, pattern, and thickness.

d Candle power distribution curves in two or more planes.

e Candle power chart 0 to 90 degrees.

f Lumen output chart.

g Average maximum brightness data in foot lamberts.

h Coefficients of utilization for zonal cavity calculations.

i Mounting or suspension details.

j Heat exchange and air handling data.

2 Exterior luminaires

a Catalog data sheets and pictures.

b Luminaire finish and metal gauge.

c Lens material, pattern, and thickness.

d IES lighting classification and isolux diagram.

e Fastening details to wall or pole.

f Ballast type, location, and method of fastening.

g For light poles, submit wind loading, complete dimensions, and finish.

3 Lamps

a Voltages (120V Only).

b Colors.

c Approximate life (in hours).

d Approximate initial lumens.

e Lumen maintenance curve.

f Lamp type and base.

4 Ballasts

a Type.

b Wiring diagram

c Nominal watts and input watts.

d Input voltage (120V unless with special permission) and power factor.

e Starting current, line current, and restrike current values.

f Sound rating.

g Temperature rating.

h Efficiency ratings.

i Low temperature characteristics.

j Emergency ballasts rating and capacity data.

PART 2 -- PRODUCTS

2.1 FIXTURES - GENERAL

A. Luminaires: Specific requirements relative to execution of WORK of this Section are located in the Luminaire Schedule on Contract Drawings.

2.2 EXTERIOR FIXTURES

A. Exterior fixtures in combination with their mounting pole and bracket shall be capable of withstanding 100 MPH winds without damage. Exterior fixtures shall have corrosion-resistant hardware and hinged doors or lens retainer. Exterior fixtures are to be photo-electrically controlled in auto-mode or manually controlled with hand off auto switch.

2.3 INTERIOR FIXTURES

A. Interior fixtures without diffusers shall be furnished with end plates. Where diffusers are required, they shall be of high molecular strength acrylic. Minimum thickness of the acrylic shall be 0.125 inches for all diffusers, except that those on 4-foot square fixtures shall be 0.187 inches thick.

B. Emergency Exit Signs

1 Internally illuminated.

2 Universal mounting type.

3 Internal cadmium battery as shown on design drawings, 90 minutes capacity to emergency lamps.

4 Two-rate regulated battery charger to minimize energy consumption. Filtered charger output to minimize voltage ripple and extend battery life. Thermal protection and current-limiting charger circuitry to prevent overheating and charger failure.

5 19,000 hours expected lamp life.

6 Press to test button.

7 Directional arrows.

8 Red letters on a white panel, 6 inches high.

C. LED

1 LED Luminaires shall be listed for locations as indicated on the fixture schedule in the Plans

2 The luminaire shall have five years' warranty, minimum, on the LED's and the driver.

3 Initial lumen output of the fixture shall meet or exceed those indicated on the fixture schedule in the Plans

4 Average delivered lumens over 50,000 hours shall be a minimum of 85% of initial delivered lumens.

5 The LEDs shall be wired in series parallel strings. The failure of one LED, and its associated string of LEDs, shall not cause the loss of more than 20% of the light output of the complete LED module.

6 Driver power factor shall be 0.9 or greater.

7 Driver total harmonic distortion (THD) shall be 20% or less

8 Current electronic photometric data in Illuminating Engineering Society (I.E.S.) format for all substitutions submitted.

2.4 LAMPS

A. Lamps shall be first-line General Electric, Cutler-Hammer, Sylvania, or equal.

2.5 PHOTO-ELECTRIC CELLS

A. Photoelectric cells for control of multiple fixtures shall be self-contained, weatherproof type, rated for 1800 VA 120-volt, single pole, single throw, and shall be provided with time-delay features. Photoelectric cell shall be **Tork Model 2101**, or equal.

2.6 FIXTURE TYPES

A. Specific requirements are located in the Lighting Fixture Schedule on the Contract Drawings.

PART 3 -- EXECUTION

3.1 LUMINAIRES

A. Install in accordance with manufacturer's recommendations.

B. Provide necessary hangers, pendants, and canopies.

C. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building required to safely mount.

D. Install plumb and level.

E. Locate luminaires to avoid both conflict with other building systems and blockage of luminaire light output.

3.2 LAMPS

A. Provide in each fixture, the number and type for which the fixture is designed, unless otherwise indicated.

3.3 CLEANING FOLLOWING INSTALLATION

A. Remove all labels and other markings, except UL listing mark.

B. Wipe luminaires inside and out to remove construction dust.

C. Clean luminaire plastic lenses with antistatic cleaners only.

D. Touch up all painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

E. Replace all defective lamps at time of Substantial Completion.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, removing site utilities and abandoning site utilities in place.
7. Temporary erosion and sedimentation control measures.

B. Related Sections:

1. Section 011000 "Summary of Work" for temporary utility services, construction and support facilities, and temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

C. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
3. All necessary closures shall be closely coordinated with the City, State, Engineer, and emergency services.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Engineer/Owner.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

None

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. The CONTRACTOR shall be responsible for obtaining and maintaining a Stormwater Pollution Prevention Plan, if necessary.

B. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion and sedimentation control Drawings and requirements of authorities having jurisdiction.

C. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

D. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

E. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

A. The gravity sanitary sewer and piping shall remain in service for the duration of the project. Removal and disposal of existing utilities serving the existing treatment facility shall not be removed until approval is given by the Engineer.

B. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

C. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place as indicated on the construction drawings.

1. Arrange with utility companies and/or Owner to shut off indicated utilities.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer and Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

E. Excavate for and remove underground utilities indicated to be removed. Unless indicated on the drawings, all removed underground utilities shall be disposed of in a lawful manner at no additional cost to the Owner.

3.4 CLEARING AND GRUBBING

A. CONTRACTOR shall remove all trees, stumps, roots, shrubs, brush, tall grass, vegetation and other debris as may be required for the proper conduct and execution of the work. All work shall be performed in a safe and prudent manner. Removal and subsequent disposal of all material shall be the complete responsibility of the CONTRACTOR. Removal means all parts of the tree or brush, including the portion of the stump within 24 inches of the ground surface. Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted.

B. Disposal of all material resulting from clearing and grubbing shall be the complete responsibility of the CONTRACTOR at no additional cost to the OWNER.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them.

B. Disposal of all material resulting from clearing and grubbing shall be the complete responsibility of the CONTRACTOR at no additional cost to the OWNER.

- END OF SECTION -

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, turf grasses and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
3. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Backfill material obtained from trenches or on on-site excavations free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious materials.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Structural Fill: Soil materials used to raise existing grades or replace less suitable material.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 10 cy for bulk excavation or 5 cy for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

3. Do not proceed with work on adjoining property until directed by Engineer.

B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Section 311000 "Site Clearing," are in place.

D. The following practices are prohibited within protection zones:
1. Erection of sheds or structures.
2. Impoundment of water.
3. Excavation or other digging unless otherwise indicated.
4. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

E. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

1.6 CONSTRUCTION CONSIDERATIONS

A. GENERAL
1. The CONTRACTOR is solely responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state, and federal safety regulations including the current OSHA Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the CONTRACTOR, who shall also be solely responsible for the means, methods, and sequencing of construction operations. Under no circumstances should the information provided below be interpreted to mean that ENGINEER or OWNER is assuming responsibility for construction site safety or the CONTRACTOR's activities; such responsibility is not being implied and should not be inferred.

B. EXCAVATION AND SLOPES
1. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. Specifically, the current OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926 should be followed. It is the ENGINEER's understanding that these regulations are being strictly enforced and if they are not closely followed, the CONTRACTOR could be liable for substantial penalties.

2. The CONTRACTOR'S "competent person", as defined in 29 CFR Part 1926, shall evaluate the soil exposed in the excavations as part of the CONTRACTOR'S safety procedures. If an excavation, including a trench, is more than 20 feet deep, it will be necessary to have the side slopes designed by a professional engineer registered in Montana.

3. The CONTRACTOR shall provide the name of their “competent person”. The CONTRACTOR's "competent person" shall establish a minimum lateral distance (two feet or greater) from the crest of the slope for all vehicles and spoil piles. Likewise, the CONTRACTOR'S "competent person" should establish protective measures for exposed slope faces.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Native Soils: In situ or excavated material for use in backfill and embankment construction moisture conditioned and compacted as required for area of use.

B. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

C. Base Course:
1. Aggregate material shall be furnished by the CONTRACTOR and the gradation of the crushed material shall meet the requirements of the gradations given in the following tables, when tested in accordance with ASTM C117 and C136.

3/4-inch Minus Surface Course

Sieve No. or Size	Percent Passing by dry weight
¾"	100
No. 4	40 – 70
No. 10	25 - 55
No. 200	2 – 12

1.5-inch Minus Crushed Aggregate Base Course

Sieve No. or Size	Percent Passing by dry weight
1½"	100
1"	90 – 100
½"	60 – 85
No. 4	45 – 65
No. 8	33 – 53
No. 200	3 – 12

PART 3 - EXECUTION

3.1 PREPARATION

A. All construction zones shall be cleared and grubbed of all stumps, logs, trees, roots, brush, weeds, tree trimmings, and other vegetation or debris in accordance with Section 311000 – Site Clearing.

B. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

C. Signs, poles, posts, and similar items to be temporarily removed and replaced are to be protected from damage during removal and replacement. Items damaged by the CONTRACTOR shall be replaced at the CONTRACTOR's expense.

D. Protect and maintain erosion and sedimentation controls during earth moving operations.

E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 BARRICADES, GUARDS AND SAFETY PROVISIONS:

A. All excavation, trenching, shoring, and the like, under this contract shall be performed in a manner that meets with the Occupational Safety and Health Standards, 24 CFR Part 1926 Excavations, as published by the Occupational Safety and Health Administration. The CONTRACTOR shall be responsible for enforcing safety and maintaining safe working conditions in the trenching operation.

B. To protect persons from injury and to avoid property damage, adequate barricades, construction signs, warning lights, and guards, as required, shall be placed and maintained during the progress of the construction work and until it is safe to resume use of the trench area. Rules and regulations of the local authorities respecting safety provisions shall be observed.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.
b. 12 inches outside of concrete forms at footings.
c. 12 inches beneath bottom of concrete slabs-on-grade.
d. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Minimum Width of Trench: The minimum width of the trench shall be such as to provide adequate room for workers to install and join the pipe and place and compact the bedding and backfill materials in the specified manner, and not less than the outside diameter (OD) of the pipe plus two feet.

2. Should the CONTRACTOR excavate a trench wider than stated above, he shall at his own expense, provide pipe bedding as defined in Part 2 of this section or take such other measures as the ENGINEER may direct to protect the pipe against the crushing forces of trench backfill. This specification requirement will be strictly enforced. Thus, if the CONTRACTOR plans to use excavating and traveling shield equipment which requires a wider trench than the minimum width/depth relationships specified above, he shall bid the job to use not less than enough "Imported Bedding Material" as required to install the pipe as shown on the Construction Drawings, absorbing the cost of providing and placing this material in either his trench excavation or pipe laying prices.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

2. The CONTRACTOR shall excavate as necessary at the locations shown on the drawings, staked in the field, or otherwise directed by the ENGINEER.

3. The CONTRACTOR shall take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs,

sidewalks, driveways, structures, and fences. Any disturbed or damaged facilities will be suitably restored or replaced at no cost to the OWNER.

4. Trenches parallel to curb and gutter, sidewalk, walls, or other structures that can be disturbed by the trenching activity, shall normally be no closer than 5 feet to the structure. Special care must be made to protect these structures.

5. Excavation shall be by open cut. Concrete and asphalt shall be saw cut in a straight line to make a neat joint with no broken corners or ragged edges, and then replaced according to these specifications. If excavation must take place near a structure, lean concrete shall be used as backfill to fully support the structure. After installing pipe and backfilling as specified, other repairs (if needed) shall be made to the ENGINEER's satisfaction.

6. In fields, rights-of-way, grassy areas or other areas where topsoil is present, the CONTRACTOR shall strip the topsoil to a depth indicated by the ENGINEER, usually 12 inches. The topsoil shall be stockpiled and placed back over the trench after backfilling to restore the area to its pre-existing conditions.

7. During excavation, materials suitable for backfilling shall be piled in an orderly manner a distance of at least two feet from the banks of the trench to avoid overloading and to prevent slides or cave-ins. Excavated material shall be stockpiled to permit access to existing buildings, hydrants, valves, manholes and other appurtenances. Surface drainage of adjoining areas shall be unobstructed.

8. Grading shall be done as may be necessary to prevent surface water from flowing into excavations, and any water accumulating therein shall be promptly removed. Under no circumstances shall water be permitted to rise in trenches until after the pipe has been placed, bedded and backfilled. Any pipe having its alignment or grade changed by floating in a flooded trench shall be re-laid at no additional cost to the OWNER.

3.7 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs, concrete pads, and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons, or similar, to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Excavate soft spots and areas of excessive pumping or rutting, as determined by Engineer, and replace with structural fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings with structural backfill placed and compacted per this specification.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Bedding Placement

1. All Bedding Material shall be placed into the trench to a maximum depth of 6 inches at any point after leveling, except bell holes shall have a depth of 3 to 4 inches. The use of bell holes and the placement of bedding shall provide for the full support of the pipe. When deposited in the trench, Bedding Material shall be

spread, graded, and initially compacted no more than necessary to insure a slightly yielding, uniform and continuous support for installed pipe at all points between pipe joints.

2. All Bedding Material above the bottom of the pipe shall be placed to fill any voids adjacent to the pipe, leveled, and thoroughly compacted by tamping, vibration, rodding, or by a combination of these methods. Special effort is required to compact the material under the pipe "haunches" to provide adequate support to the pipe. Placement techniques are to avoid damage to the pipe, coating on pipe and fittings, joint bonds, and corrosion protection materials. Bedding adjacent to and over the pipe is to be placed in layers not to exceed 6 inches, with each layer thoroughly compacted. Bedding adjacent to the pipe is to be placed and compacted on both sides simultaneously. Water settling of bedding is not allowed. All backfill material, equipment used, and the results obtained in placing fill material shall be subjected at all times to the approval of the pipe manufacturer and the ENGINEER.

D. BACKFILL ABOVE BEDDING MATERIAL

1. After placing Bedding Material as specified above, the remainder of the backfill in the zone designated “Backfill Above Bedding" shown on the Construction Drawings shall be placed as herein specified, in lifts not to exceed 8 inches (compacted thickness). In this zone, backfill may be placed by machine or other method or combination of methods approved by the ENGINEER, which will not impose excessive, concentrated, or unbalanced loads, thus transmitting a shock or impact to the embedded pipe which might result in damage to, or displacement of the pipe. Frozen material, snow or mud shall not be used in backfill.

2. Backfill compaction up to the bottom of the road surface of surface restoration section or up to grade for unsurfaced sections shall be compacted to not less than the following percentages of maximum density, as determined by ASTM D698.

    - Asphalt pavement - ninety-five percent (95%);
    - Portland cement concrete surface - ninety-five percent (95%);
    - Gravel surface - ninety-five percent (95%);
    - Unsurfaced areas - ninety percent (90%).

3. For backfill which shall be compacted or consolidated to a density equal to or greater than ninety percent (90%), the material shall be placed in continuous horizontal layers not to exceed the uncompacted depth of 12 inches. The CONTRACTOR shall add water or aerate material as required in placing compacted backfill to bring the material within 3% optimum moisture content. In locations where 95% compaction is specified and the excavated soil materials possess natural moisture in excess of 6% above optimum moisture as determined by ASTM D698, the material will be considered unsuitable for backfill. Either the CONTRACTOR or ENGINEER may perform the field tests to determine the in situ moisture content. When the ENGINEER determines the excavated material is unsuitable, it shall be processed by the CONTRACTOR to reduce the moisture content to an acceptable level or removed and disposed of at location of the borrow source, or at locations secured by the CONTRACTOR and approved by the ENGINEER. If the moisture content is between 3 and 6%

over optimum, the CONTRACTOR shall blend or aerate the material to reduce it to less than 3% over.

4. CONTRACTOR will be responsible for all costs of excavation, haul, placement and compaction of the replacement material from a CONTRACTOR secured source.

5. If the CONTRACTOR performs winter construction, frozen material or material containing frozen chunks, mud or snow, must be replaced at the CONTRACTOR's cost.

6. Where surface restoration is not specified, the CONTRACTOR shall grade all backfill surfaces and shall maintain them during the period of this contract in such a manner as to provide safe travel by the public, free of settlement, mud holes, ruts and high centers at no additional cost to the OWNER.

7. The CONTRACTOR may substitute lean concrete (flowable fill) in areas under streets and roads at his cost if allowed by the ENGINEER, and shall utilize lean concrete if required by the drawings.

8. Backfill around hydrants, valve boxes, manholes, inlet boxes or similar appurtenances shall be hand compacted.

E. Backfill voids with soil while removing shoring and bracing.

F. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation. See Section 3.21 for requirements

G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use appropriately conditioned native soil material.
2. Under walks and pavements, use appropriately conditioned native soil material.
3. Under steps and ramps, use engineered/structural fill.
4. Under building slabs, use engineered/structural fill.
5. Under footings and foundations, use engineered/structural fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

1. Heavy compaction equipment shall not be operated within 4-feet of concrete walls.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.

D. Backfill material to be “benched” into existing embankments or berms. Benches to extend into the existing slope a minimum of 24-inches to provide secure bonding of the new embankment fill to the existing slope.

E. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus ½ inch.

3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

D. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of ½-inch when tested with a 10-foot straightedge.

3.16 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Where indicated, install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course and base course to required crown elevations and cross-slope grades.
4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.17 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.18 SURFACE RESTORATION:

A. GRAVEL ROADWAYS OR PARKING AREAS
   1. Restore to pre-existing condition or better, but not less than 6 inches of ¾" minus crushed base course.

B. WATER POLLUTION CONTROL
   1. Water pollution from disturbed areas is to be controlled. Measures used are to comply with appropriate local, state and federal regulations.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

   1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF EXCESS EXCAVATED MATERIAL:

A. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of the work. Broken concrete, asphalt and other coarse debris resulting from pavement or sidewalk removal; excavated rock in excess of the amount permitted to be and actually installed in trench backfill; junk and debris encountered in excavation work; and other similar waste materials shall be legally disposed of away from the site of the work at the CONTRACTOR's expense. In some cases excess material must be placed on the property of the landowner where it came from (see drawings). Excess material may be taken to a landfill.

B. Excess excavated material not stockpiled as requested by the property owner, shall be disposed of by the CONTRACTOR at his own expense, except as discussed below. The OWNER reserves the right to claim any excess material. The CONTRACTOR shall load the OWNER's trucks. If required by the project Special Provisions or Project Manual, the CONTRACTOR shall haul excess material to a location designated by the OWNER.

C. Excess earth from excavations located in open fields and unimproved property may be distributed directly back over the pipe trench and within the pipeline easement (below the topsoil) to a maximum depth of 6 inches above the original ground surface elevation, at and across the trench, and sloping uniformly each way therefrom. Material thus placed shall be carefully finished with a drag, blade machine, or other suitable tools, to a smooth, uniform surface without obstructing drainage at any point. This

practice shall not be used if the slight mounding interferes with irrigation practices. Wasting of excess excavated material in the above manner also will not be permitted where the line of trench crosses public road rights-of-way or is within said rights-of-way, and more or less parallels the centerline thereof.

D. No payment will be made separately or directly for haul on any part of the work. All hauling will be considered a necessary and incidental part of the work, and its cost shall be considered by the CONTRACTOR and included in the contract unit price for the pay items of work involved.

- END OF SECTION -

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temporary excavation support and protection systems.

B. Related Sections:
   1. Section 011000 "Summary of Work" for temporary utilities and support facilities.

1.3 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

   1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   2. Prevent surface water from entering excavations by grading, dikes, or other means.
   3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
   4. Monitor vibrations, settlements, and movements.

1.4 ACTION SUBMITTALS

A. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Other Informational Submittals:

   1. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the

absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.

2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.

    a. Note locations and capping depth of wells and well points.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Engineer no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Engineer's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
2. The geotechnical report is referenced elsewhere in the Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that are either new or in serviceable condition which will is suitable for shoring and/or bracing the imposed load.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Engineer.
2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.3 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in

stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 96 inches below overlaying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
3. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

- END OF SECTION -

SECTION 33 01 10 - DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Disinfection of treatment plant works and disinfection of potable water distribution and transmission system.
2. Testing and reporting of results.

1.2 WARNING: NF MEMBRANES WILL BE DAMAGED IF EXPOSED TO OXIDANTS. Do not install membranes until after all disinfection procedures have been completed and all oxidants removed from the system upstream of the NF membrane skid. Follow NF skid manufacturers procedures for installation of membranes.

1.3 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA B300 - Hypochlorites.
2. AWWA C651 - Disinfecting Water Mains.
3. AWWA C653 – Disinfection of Water Treatment Plants

1.4 SUBMITTALS

A. Disinfection Procedure:

1. Submit description of procedure, including type of disinfectant and calculations indicating quantities of disinfectants required to produce specified chlorine concentration.

B. Product Data: Submit manufacturer information for proposed chemicals and treatment doses.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Certify that final water complies with disinfectant quality standards of Alaska Department of Environmental Quality.

E. Test and Evaluation Reports: Indicate testing results comparative to specified requirements.

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

G. Qualifications Statements:

1. Submit qualifications for manufacturer and applicator.

1.5 CLOSEOUT SUBMITTALS

A. Disinfection Report:

1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and completion.
3. Test locations.
4. Name of person collecting samples.
5. Initial and 24-hour disinfectant residuals in treated water in ppm for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing [**in ppm**] for each outlet tested.

1.6 QUALITY ASSURANCE

A. Perform Work according to AWWA C651 and/or C653 as required.

1.7 QUALIFICATIONS

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

B. Applicator: Company specializing in performing Work of this Section with minimum three years of documented experience.

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals:

1. Hypochlorite: Comply with AWWA B300.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017700 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that piping system has been cleaned, inspected, and pressure tested.

C. Verify that all pipe, valves, and fittings have been installed as indicated on the drawings or as required to provide a complete and operational system.

D. Perform scheduling and disinfecting activity with startup, water pressure testing, adjusting and balancing, and demonstration procedures, including coordination with related systems. Coordinate all activities with operators to ensure adequate treated water levels in the storage tank at all times.

3.2 INSTALLATION

A. Provide required equipment to perform Work of this Section.

B. Introduce treatment into piping system.

C. Maintain disinfectant in system for a minimum of 10 hours.

D. Flush, circulate, and clean until required disinfectant quality standard has been achieved using City of Thorne Bay municipal water supply.

E. Replace permanent system devices that were removed for disinfection.

3.3 FIELD QUALITY CONTROL

A. Section 014500 - Quality Requirements: Requirements for inspecting and testing.

B. Disinfection, Flushing, and Sampling:

1. Disinfect pipeline installation according to AWWA C651 and piping inside the treatment plant according to AWWA C653.
2. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
3. Disposal:

    a. Legally dispose of chlorinated water.
    b. Apply neutralizing chemical to chlorinated water as it exits the system during flushing to neutralize chlorine residual remaining in water discharged to ground.

4. After final flushing and before pipeline is connected to existing system or placed in service, certify that disinfectant level meets quality standards of Alaska Department of Environmental Quality.

- END OF SECTION -

SECTION 33 05 05.31 - HYDROSTATIC TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Hydrostatic testing of pressure piping.

1.2 SUBMITTALS

A. Submit following items prior to start of testing:

1. Testing procedures.
2. List of test equipment.
3. Testing sequence schedule.
4. Provisions for disposal of flushing and test water.
5. Certification of test gage calibration.

B. Test and Evaluation Reports: Indicate results of piping tests.

C. Qualifications Statement:

1. Qualifications for Contractor.

1.3 QUALITY ASSURANCE

A. Perform Work according to AWWA C600 standards.

B. Contractor: Company specializing in performing Work of this Section with a minimum of three years' experience.

PART 2 - PRODUCTS

2.1 HYDROSTATIC TESTING

A. Equipment:

1. Pressure pump.
2. Pressure hose.
3. Water meter.
4. Test connections.
5. Pressure relief valve.
6. Pressure Gage: Calibrated to 0.1 psi.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping is ready for testing.

B. Verify that trenches are backfilled to a minimum of ½ pipe diameter.

C. Verify that pressure piping thrust restraints have been installed.

3.2 FIELD QUALITY CONTROL

A. Testing of Pressure Piping:

1. Test system according to AWWA C600 and following:

a. Hydrostatically test each portion of pressure piping, including valved sections, but excluding vendor equipment.

b. Conduct hydrostatic testing for at least two hours.

c. Slowly fill with water portion of piping to be tested, expelling air from piping at high points.

d. Install corporation cocks at high points for buried piping and air release valves inside the building as shown on the drawings.

e. Close air vents and corporation cocks after air is expelled.

f. Raise pressure to specified test pressure.

g. Observe joints, fittings, and valves undergoing testing.

h. Remove and renew cracked pipes, joints, fittings, and valves that show visible leakage.

i. Retest.

j. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.

k. Maintain pressure within plus or minus 5.0 psi of test pressure.

l. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of testing.

m. Compute maximum allowable leakage using following formula:

1) L = [**SD x sqrt(P)**]/C.

2) L = testing allowance, gph.

3) S = length of pipe tested, feet.

4) D = nominal diameter of pipe, inches.

5) P = average test pressure during hydrostatic testing, psig.

6) C = 148,000.

7) If pipe undergoing testing contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each pipe size.

2. If testing of piping indicates leakage greater than that allowed, locate source of leakage, make corrections, and retest until leakage is within acceptable limits.

3. Correct visible leaks regardless of quantity of leakage.

- END OF SECTION -

SECTION 33 09 10 – INSTRUMENTATION AND CONTROL FOR WATER UTILITIES

PART 1 - GENERAL

1.1 BASIS

A. This Specification includes instrument details for all new or modified items located in the water treatment plant. For details on control strategy and operating sequences see Section 33 09 12.

B. Related documents: see the instrument list included in the drawing set.

1.2 SECTION REQUIREMENTS

A. Submittals: Product Data adequate to demonstrate compliance with any and all specifications outlined in this document and referenced specifications.

B. Warranty: Provide copies of manufacturer's standard limited warranty for all units placed in service.

C. Manuals: Provide Owner's Representative with a copy of all manuals for each unit placed in service.

D. Electrical Requirements: See Division 26 and 40 for requirements.

1.3 FIELD TESTS

A. Tests shall be conducted by a factory trained, qualified representative. All system components shall be checked to verify they have been installed properly and that all terminations have been made correctly and all deficiencies and irregularities shall be corrected.

B. Witnessed Field tests shall be performed on the complete system.

C. Each function shall be demonstrated to the satisfaction of the Owner's Representative.

D. Each test shall be witnessed and signed off by the system supplier and the Owner's Representative upon satisfactory completion.

E. Provide written certification from the manufacturer to the Owner's Representative that the installation is in accordance with the manufacturer's requirements and the warranty is validated.

PART 2 - PRODUCTS

2.1 INSTRUMENTS AND GAUGES

A. Chlorine Analyzer System

1. System Description:
   a. The objective of this unit is the collection and reporting of free chlorine level, pH, and temperature of water being sent to distribution.
   b. The amperometric chlorine analyzer shall be designed for continuous measure of free chlorine, pH and temperature in aqueous solutions. The chlorine analyzer system shall include a Hach CLF10 sc analyzer and a SC200 Dual Input controller with added expansion module for a total of five 4-20mA outputs or approved equal.

2. Measurement Procedures
   a. The method of measuring free or total chlorine will be with a three-electrode amperometric sensor immersed into an electrolytic medium with a membrane, selective to chlorine, separating it from the sample.

3. Alternates
   a. Other methods of chlorine measurement, such as two-electrode amperometric, open cell amperometric, or measurements with external pH compensation are not acceptable. Methods requiring reagents are also not acceptable for this installation.

4. Performance Requirements
   a. Chlorine:
      1) Measurement range: 0 to 5 mg/L (ppm) free chlorine residual
      2) Accuracy: ± 5% of reading or ±0.03 mg/L (ppm), whichever is greater
      3) Precision: 5% of reading or 0.01 mg/L (ppm), whichever is greater
      4) Minimum detection limit: 0.03 mg/L (ppm)
      5) Resolution: 0.01 mg/L (ppm)
      6) Repeatability: 5% of reading or 0.05 mg/L (ppm), whichever is greater
      7) Cycle Time: 2.5 minutes maximum

   b. pH:
      1) Measurement range: 2.0 to 12.0 pH
      2) Repeatability: 0.1%

   c. Temperature:
      1) Measurement range: 32 to 113 ºF
      2) Accuracy: ±1 ºF

5. Operational Criteria

   a. Sample flow rate: 200 to 500 mL/minute

   b. Sample pressure (with conditioning kit if required): 120 psi (8.27 bar)

   c. Sample temperature: 41 to 104 °F (5 to 40 °C)

   d. Operating temperature: 41 to 104 °F (5 to 40 °C)

   e. Operating humidity: 90% at 40 °C maximum

6. Accessories:

   a. SC Controller:
      1) System Description:
         A modular single or dual channel controller that works with analog sensor modules and/or digital sensors, Hach model SC200 or approved equal.

      2) Controller shall be equipped with a minimum of **four** analog 4-20 mA outputs with a maximum impedance of 500 ohms. Controller shall be capable of reporting free chlorine, pH and temperature.

      3) The controller shall accept 4 different analog sensor modules in any combination to measure the following:
         a) pH/ORP module

         b) Conductivity module
            1. Contacting conductivity

            2. Inductive conductivity

            3. Cationic conductivity (Calculated pH)

         c) Dissolved Oxygen module

         d) Analog mA IN module

      4) Power Requirements:
         a) Voltage: 120V AC
         b) Frequency: 60 Hz
         c) Phase: 1
         d) Power: 37 W with 25 W sensor/network card load.

      5) The controller shall be equipped with an SD card reader for data download and controller software upload.

6) Four electromechanical, UL rated, SPDT relays shall be provided for user-configurable contacts rated 100 to 230 VAC, 5 Amp at 30 VDC resistive maximum.

b. pH sensor:
1) Optional pH sensor shall be included with the chlorine analyzer configuration.

7. Components:
a. Standard Equipment
1) Stainless steel mounting panel
2) Chlorine sensor with Membrane and Electrolyte
3) Chlorine sensor flow cell
4) Flow meter with control valve
5) Digital gateway to sc controller with cable
6) The analyzer must be housed in a NEMA 4X enclosure that is IP65 rated with the gasketed door latched.

b. Dimensions
1) Sensor:
a) Length: 7.68 inches
b) Diameter: 0.98 inches
2) Panel:
a) Length: 19.0 inches
b) Width: 19.5 inches
c) Depth: 5.95 inches
3) Gateway to Controller cable: 3 ft minimum

8. Pre-Approved Manufacturers:

a. Hach Company, Loveland, CO
1) Model CLF10 Chlorine Analyzer with pH compensation option and optional pH sensor, Free Chlorine Residual.
2) Hach model sc200 Controller

b. Chemtrac Inc., Norcross, GA, Model HydroACT with temperature and pH compensation option, Free Chlorine Residual.

B. Pressure gauges

1. Bourdon tube style 4.5” or 6” face liquid filled pressure gauge.

a. Range 0 – 200 psig

b. Liquid filled with Glycerin

c. 316 SS case

2. Pre-approved model: Ashcroft Type 1009 (others with engineering approval)

C. Pressure switch

1. Double set point, field adjustable, IP65 rated pressure switch.

2. Pre-approved model: Ashcroft GP Series, model GPD-N4-GG-B-25-200PSI (others with engineering approval)

D. Pressure transmitter

1. Adjustable pressure range as needed to match the parameters of the system (0-200 psi).

2. Accuracy of +/- 0.5 of full operating range.

3. All wetted parts NSF-61 compliant.

4. Provide 4-20 mA output signal.

5. Pre-approved model: Rosemount model 3051CG or CD for differential pressure applications.

E. Flow Meter

1. Pre-approved model: Rosemount 8750W series, 4" flowtube, flanged ends, integral transmitter mount.

2. Transmitter Output: 4-20 mA

3. Flanged magnetic style flow tube, PTFE liner, 316 SS electrode.

4. Capable of processing signals from fluids that are traveling between 0.04 and 39 ft/s (0.01 to 12 m/s) for both forward and reverse flow.

5. Power Requirements:
   a. Voltage: 120V AC
   b. Frequency: 60 Hz
   c. Phase: 1

6. Accuracy of ±0.5% within normal operating range.

F. Sample Taps:

1. Connections: 1/2"(M) NPT inlet by plain-end spout.

2. Ball or needle valve design with smooth-nosed spout.

3. Functions: drip-tight shut-off; sample draw flow control.

4. Body: Brass, chrome plated, lead free.

G. New Turbidity Meters

1. Pre-approved instruments for this application are Hach TU5300 (four required) with Hach SC200 controller (reuse two existing, one new required). Alternates will be considered with Engineers approval; however, Owner prefers to use Hach equipment to match existing.

2. There are four existing turbidity meters in the current water treatment plant (AE-510/511/512/513). One turbidity meter for the filtered water outlet of each filter and one combined treated water turbidity meter. Sample points are in the filter room and meters are located in the lab area. The three individual turbidity units will be removed and replaced with new Hach TU5300 units. The one combined turbidity unit will be removed and replaced with a new Hach TU5300 unit. All existing 1720e units will be saved and returned to the Owner. One unit will be selected (by Owner) for reinstallation (by Contractor) as a raw water turbidity meter (AE-110).

3. Final configuration will be four new TU5300 and one existing 1720e, all located on the south wall of the main filter room in the location previously occupied by control panels. New tubing from the existing sample point to the new meter locations shall be field routed to minimize tubing length. One new sample point for raw water shall be installed just downstream of the self-backwashing screen outlet block valve (between HV-111 and Tie-Point 2) on the side of the raw water pipe. A new 2" field routed pvc line will be required to collect water from the drains of all instruments and route to the existing wastewater floor drain.

2.2 BUILDING ALARMS

A. Door Alarms:

1. One intrusion alarm for each door is required for this installation, including existing doors.

2. 3/4" recessed door contacts on the door.

3. Delay timer and acknowledge code in PLC.

4. GE intrusion switch 2500 Series or engineering approved equal.

B. High Low Temperature Alert:

1. Mechanical temp alert that requires no power for operation.

2. Adjustable high and low set points

3. 2 dry contact closure contacts for high and low alarms.

4. Dayton Line voltage thermostat, Model 2E816 or engineering approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment as per manufacturer's recommendations.

3.2 TESTING AND STARTUP

A. All elements of the control system shall be tested to demonstrate a fully functional control system.

B. Control system supplier shall provide all special testing materials and equipment.

C. Coordinate and schedule all testing and start up work with the Owner's Representative.

3.3 TRAINING

A. Provide a minimum on site 8-hour training to demonstrate operation of all control system components.

B. Instructors shall be thoroughly trained in operating theory as well as practical operation and maintenance work for each component of the system.

- END OF SECTION -

SECTION 33 09 12 – WATER TREATMENT PLANT OPERATING SEQUENCE

PART 1 - GENERAL

1.1 BASIS

A. This Specification includes details of the water treatment plant operating sequence and control strategy descriptions for all automated valves, instruments, and equipment located in the existing and new expanded water treatment building.

B. Related documents:
   1. Piping & Instrumentation (P&ID) schematic drawings with all valve and instrument tags identified.
   2. Piping drawings showing new and existing piping, valves, actuators, instruments, and equipment.
   3. Instrument specification, section 33 09 10.
   4. Valve and actuator specification, section 40 11 11.

1.2 SECTION REQUIREMENTS

A. Submittals: Product Data adequate to demonstrate compliance with any and all specifications outlined in this document and referenced specifications.

B. Warranty: Provide copies of manufacturer's standard limited warranty for all units placed in service.

C. Manuals: Provide Owner's Representative with a copy of all manuals for each unit placed in service.

D. Electrical Requirements: See Division 26 and 40 for requirements.

1.3 FIELD TESTS

A. Tests shall be conducted by a factory trained, qualified representative. All system components shall be checked to verify they have been installed properly and that all terminations have been made correctly and all deficiencies and irregularities shall be corrected.

B. Witnessed Field tests shall be performed on the complete system.

C. Each function shall be demonstrated to the satisfaction of the Owner's Representative.

D. Each test shall be witnessed and signed off by the system supplier and the Owner's Representative upon satisfactory completion.

E. Provide written certification that from the manufacturer to the Owner's Representative that the installation is in accordance with the manufacturer's requirements and the warranty is validated.

PART 2 - PRODUCTS

2.1 NONE – see referenced specification sections.

PART 3 - EXECUTION

3.1 EXISTING TREATMENT PROCESS AND PLANNED UPGRADES

A. General Process description: The current water treatment plant generally consists of a surface water source, chemical injection, coagulation / aging, filtration, additional chemical injection / disinfection, and storage. This project will upgrade the existing plant to add an additional filtration step.

B. The raw water source is Water Lake located to the NE of the water treatment plant. No modifications are being made to the raw water system. The current system includes a screened intake, vertical submerged pump, and transmission line with air release and vacuum breaker valves. Provision is included for line purging with a self-priming trailer mounted pump.

C. Raw water enters the treatment building, is screened through an in-line strainer, and coagulant is added upstream of a static mixer. This project will replace the aging in-line strainer with a new self-backwashing filter (SC-100). Screened water then flows into the aging tank where 41 minutes of reaction time occurs at the design flow rate of 60 gpm. No modifications to the chemical injection system are included in the project.

D. After leaving the aging tank, the raw water is split into three flow paths. Each flow path leads to one of three existing multi-media filter vessels. Extensive additions to the valving around each filter vessel are included in the project and described in the drawings and specifications. A majority of the work around the filter vessels is the addition of new actuators on all existing Bray butterfly valves.

E. Filtered water leaves the filter vessels and is currently pH adjusted with soda ash and chlorinated prior to entering the storage tank. This project will add a new filtration step (skid mounted NF filter) after the existing filter vessels and before the chemical injection / chlorination point. A NF system bypass valve (HV-501) will be provided for maintenance on the NF system.

F. After chlorination, treated water enters the existing 280,000 gallon storage tank prior to being sent to town via the existing distribution system. No modifications to the storage tank or distribution piping are included in this project; however, a new flow meter (FE-600) is being added in the line that feeds the distribution system as well as new chlorine / pH / temperature instruments (AE-600/601) for treated water compliance data collection.

3.2 FILTRATION OPERATING SEQUENCE

A. This section includes a step-by-step operating sequence for the existing multi-media filter vessels. This description is provided to assist with programming a new PLC to operate the existing filters after new valve actuators have been installed.

B. All three filter vessels are identical and normally operate in parallel. The operating sequence below is for a single filter (PF-500), but can be applied to all filters. Design flow for the treatment plant is 60 gpm raw water flow with 20 gpm through each filter.

C. Normal system start / stop is controlled by the level in the storage tank LIT-600 which is operator adjustable. When the tank low level is reached, valve MV-105 opens which causes low pressure in the inlet line and PS-100 (at the raw water pump) starts the pump P-100. Raw water then flows to the treatment plant and is screened through the new self-backwashing filter SC-100, coagulant is added, and contact time is provided in the aging tank. Water then flows to the filters.

D. Filtration Mode:
   1. This is the normal filtration mode with coagulated raw water entering the top of the vessels and filtered water exiting the bottom through the flow regulator.
   2. Raw water inlet valve MV-200, filtered water outlet valve MV-500, and filtered water header valve MV-503 are all open.
   3. Backwash water inlet valve MV-400, backwash water outlet valve MV-300, air scour inlet valve MV-203, filter to drain valve MV-306, and headspace drain-down valve MV-301 are all closed.

E. Backwash Sequence Initiate:
   1. A backwash sequence will be initiated either by high differential pressure on PDI-500 or by high turbidity on all filters (TU-503 / AIT-503) or any individual filter turbidity meter (AE-510). Any backwash trigger will cause all filters to go through a backwash sequence. A full backwash sequence consists of a drain-down, air scour, backwash, and filter to drain as described in the following sections.
   2. Initial setpoint for high differential pressure is 5 psig.
   3. Initial setpoint for high outlet turbidity is 0.1 NTU.
   4. Setpoints for both high differential pressure and high outlet turbidity shall be operator adjustable.

F. Drain-down Mode:
   1. The headspace of each filter must be drained prior to starting the air scour system to allow room for air expansion of the filter media and room for air to separate from the water prior to exiting the top of the filter.
   2. Once a backwash sequence has been initiated, the first step is to switch from filtration mode to drain-down mode by closing MV-200, MV-500, and MV-503.
   3. Drain the filter vessel headspace by opening MV-301 for 30 seconds. This time value shall be operator adjustable.
   4. At the end of the timer, close MV-301.

G. Air Scour Mode:
   1. The air scour mode is intended to significantly agitate the filter media in order to loosen up any coagulated particles lodged in the media or stuck to the top of the media.

2. Air scour begins with starting the blower (B-200) and opening MV-203.
3. Air scour continues for two minutes and excess air vents through AV-500. This time value shall be operator adjustable.
4. At the end of the timer, close MV-203 and stop the blower.

H. Vessel Fill Mode:
1. After an air scour, the top section of the filter vessel must be purged of air prior to starting the backwash sequence.
2. To prevent settling of agitated material, the fill mode should be started as quickly as possible after the air scour. To facilitate this, the backwash pump P-410 should be started approximately 2 seconds prior to the end of Air Scour Mode.
3. After backwash pump start, activate the solenoid valve on FCV-410, the low flow ClaVal that controls the fill rate to the filtration vessel.
4. Open backwash valve MV-400. At this point, all other MOV's should be closed. Remain in this state for 20 seconds (this timer value shall be operator adjustable).
5. Open backwash outlet valve MV-300 and continue for an additional two minutes (this timer value shall be operator adjustable).

I. Backwash Mode:
1. The Backwash Mode is intended to remove all contaminants, dirt, coagulated material, etc. from the filter vessels after the air scour loosens this material.
2. After Vessel Fill is completed, deactivate the solenoid valve on FCV-410 and activate the solenoid valve on FCV-411, the high flow ClaVal that controls the backwash flow rate to the filtration vessel.
3. Backwash continues for 10 to 15 minutes. This value shall be operator adjustable.
4. After the backwash timer completes, stop backwash pump P-600, deactivate the solenoid valve on FC-411, close backwash outlet valve MV-300, and close backwash inlet valve MV-400.

J. Filter to Waste:
1. Filter to waste is intended to condition the filter media and ensure filtration is occurring within normal operating parameters.
2. After completion of backwash mode, open the following valves: filter to waste valve MV-306, filter outlet valve MV-500, and raw water inlet valve MV-200.
3. Run in filter to waste mode for approximately 5 minutes. Begin monitoring the filtered water outlet turbidity.
4. Once the outlet turbidity has dropped below a value of 0.2 NTU for more than 30 seconds, open filtered water header valve MV-503 and close filter to waste valve MV-306.

K. Filtration Mode:
1. See section C above.

3.3 INSTALLATION

A. Install equipment as per manufacturer's recommendations, referencing valve and actuator, instrument, and electrical specification sections as appropriate.

3.4 TESTING AND STARTUP

A. All elements of the control system shall be tested to demonstrate a fully functional control system.

B. Control system supplier shall provide all special testing materials and equipment.

C. Coordinate and schedule all testing and start up work with the Owner’s Representative.

3.5 TRAINING

A. Provide a minimum of three 8-hour training days to demonstrate operation of all control system components.

B. Instructors shall be thoroughly trained in operating theory as well as practical operation and maintenance work for each component of the system.

- END OF SECTION -

SECTION 40 05 31 – POLYVINYL CHLORIDE PROCESS PIPE

PART 1 -- GENERAL

1.1 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to install and test all thermoplastic pipe and associated fittings.

1. Extent of piping is shown and shall be in accordance with piping schedules in Section 40 11 09, Interior Piping.

B. Related Sections:

1. Section 401109 Interior Piping

2. Section 401111 Valves and Actuators

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

2. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.

3. ASTM D2466, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

4. ASTM D2467, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

5. ASTM D2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

6. ASTM D2665, Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

7. ASTM D3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

8. ASTM D3035, Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

9. ASTM D3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

10. ASTM D3212, Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

11. ASTM D3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

12. ASTM F441/F441M, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

13. ASTM F477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

14. ASTM F1336, Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings.

1.3 SUBMITTALS

B. Shop Drawings:

1. Submit piping layout Shop Drawings in accordance with Section 40 11 09, Interior Piping.

2. Submit product data on pipe, fittings, gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.

3. Submit manufacturer's certificate of compliance standards referenced in this Section.

PART 2 -- PRODUCTS

2.1 SERVICE CONDITIONS

A. General:

1. Pipe materials shall be suitable for services intended. Refer to piping schedules in Section 40 11 09, Interior Piping.

2. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.

3. Pipe, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in ANSI/NSF 61 as being suitable for contact with potable water, and shall comply with requirements of the authorities having jurisdiction at the Site.

2.2 POLYVINYL CHLORIDE (PVC) PIPING

A. PVC Pipe — General Applications: Unless otherwise shown or indicated, PVC pipe shall comply with the following:

1. Manufacturers: Provide products of one of the following:

a. Ipex, Inc.

b. Spears Manufacturing Company.

c. Or equal.

2. Material: Unless otherwise specified, comply with the following:

a. Type and Grade: Type 1, Grade 1.

3. Wall Thickness: Schedule 80 complying with ASTM D1784 and ASTM D1785, and US Product Service PS 21-70 as having same outside diameter dimension as cast-iron pipe.

4. Temperature Rating: Rated for temperature to 140 degrees F.

5. Color: Gray.

B. Fittings: Type, grade, schedule, and color of fitting shall match the associated pipe.

1. Solvent Weld: Comply with ASTM D2467.

2. Threaded: Threaded fittings shall comply with ASTM D2464.

3. Flanged: Provide flanged fittings with Neoprene gaskets.

C. Joints:

1. Solvent Weld: Use primer and solvent cement recommended by PVC pipe manufacturer for the application. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.

2. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe shall not be threaded.

3. Flanged: Provide with backup flange minimum 1/8-inch thick. Backup flanges and connecting bolts shall be Type 304 stainless steel.

PART 3 -- EXECUTION

3.1 INSPECTION

A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

A. For exposed piping installation, refer to Section 40 11 09, Interior Piping.

- END OF SECTION -

SECTION 40 11 09 INTERIOR PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. The work specified under this section includes furnishing and installing all piping located in the interior of the water treatment plant building.

1.2 RELATED WORK:

A. Section 33 05 05 – Hydrostatic Testing

B. Section 33 01 10 – Disinfection of Water Utility Piping

C. Section 09 90 00 – Painting and Coating

1.3 SUBMITTALS:

A. Submittals: Product Data adequate to demonstrate compliance with any and all specifications outlined in this document and referenced specifications.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE:

A. Ductile Iron Pipe: Ductile iron pipe shall be used where indicated on the drawings or specified. Pipe sizes shall be as indicated on the drawings.

1. All pipe, fittings, and accessories shall conform to the following American Water Works Association (AWWA) standards as applicable.

a. AWWA C104 - Cement-Mortar Lining for Ductile-Iron and Gray Iron Pipe and Fittings for Water

b. AWWA C110 - Gray-Iron and Ductile-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids

c. AWWA C115 - Flanged Cast-Iron and Ductile-Iron Pipe With Threaded Flanges

d. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

B. Pressure Class: Ductile iron pipes shall be Class 250 conforming to AWWA C151. Pipe shall be factory coated for corrosion protection or field coated as per Section 09 90 00.

2.2 STEEL PIPE:

A. General: Steel pipe shall be used where indicated on the drawings or where specified. Interior water piping, fittings and connecting procedures shall be in conformance with the latest edition of the Uniform Plumbing Code.

1. All steel pipe, fittings, and accessories shall conform to the following American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), and American Water Works Association (AWWA) standards and specifications as applicable. See the sections following this listing for specific references to these standards.

a. ANSI B1.20.1 - Pipe Threads

b. ANSI B16.9 - Factory-Made Wrought Steel Butt Welding Fittings

c. ANSI B36.10 - Welded and Seamless Wrought Steel Pipe

d. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

e. ASTM A105 - Forgings Carbon Steel for Piping Components

f. ASTM A307 - Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength

g. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperature

h. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water

i. AWWA C153 - American National Standard for Ductile-Iron Compact Fittings, 3-inch through 24-inch and 54-inch through 64-inch, for Water Service

j. AWWA C200 - Steel Water Pipe 6 In. and Larger

k. AWWA C206 - Field Welding of Steel Water Pipe

l. AWWA C207 - Steel Pipe Flanges for Waterworks Service – 4 In. through 144 In.

m. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings

n. AWWA C210 – Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines

o. AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

p. AWWA C606 - Grooved and Shouldered Joints

B. Pipe: Steel pipe shall conform to ASTM A53 (Grade B) or ASTM A139 (Grade B) or AWWA C151, ANSI B36.10 and AWWA C200, where applicable. Steel pipe shall be standard thickness. Minimum yield strength shall be 35,000 psi.

C. Joints: For 4-inch diameter and larger pipe, the pipe ends shall be beveled for welding where flanged or grooved ends are not provided. Joints for smaller than 4-inch pipe shall be screwed, unless flanged ends are called for in the Drawings.

1. Welded Joints: Welded joints in the steel pipe shall be butt-welded in compliance with AWWA C200, and field welds shall conform to AWWA C206. A single butt weld on the exterior of the pipe shall be used. The welded joints shall not create a deflection at the joint of more than 0.4 percent (1" in 20').

2. Screwed Joints: Threads shall comply with ANSI B1.20.1.

3. Flanges: Flanges shall be attached to the steel pipe at all locations shown on the Drawings and/or as needed to properly install the pipe as indicated in the Drawings. Flanged fittings shall be used for all connections to pumps and to valves 4-inches and larger. Flanges shall be ASME B16.5, Class 300, flat faced and attached by two fillet welds. Gaskets shall be ⅛" thick full-faced rubber. Bolts shall be galvanized conforming to ASTM A307 or equivalent stainless steel. The attaching of flanges shall comply with AWWA C207 and field welds shall conform to AWWA C206.

4. Dismantling Joints: Dismantling joints shall consist of telescoping, AWWA C207, Class F, flanged fittings with fully restrained tie rod restraints. Flange spool piece shall be ductile iron with Class F steel ring flange. End ring and body shall be made of ASTM A36 steel. Gaskets shall be NTR. Fittings shall be coated and lined with fusion bonded epoxy, NSF61 certified. Telescoping range shall be two inches for 12-inch and smaller fittings and 3-inches for 14-inch and larger fittings. Bolts shall be carbon steel or similar. Stainless steel bolts are not required. Flanged dismantling joints shall be Romac Style DJ400, or approved equal, and rated for 300 psi operating pressure.

5. Flanged Coupling Adapters: Flanged coupling adapters (FCA) shall be used only if indicated on the Drawings and include anchor pin for thrust restraint. Body shall be ASTM A53 steel and ANSI 150 # flange drilling. Bolts shall be manufacturer's standard steel bolt material. Gasket material shall be Nitrile, and finish shall be fusion bonded epoxy inside and out. FCA's shall be Romac FCA501, Smith-Blair Series 913, or approved equal,

D. Fittings:

1. General: All steel fittings shall comply with ANSI B16.9, ASTM A234, AWWA C200 and AWWA C208. Flanges, welds and threads shall be as covered above for steel pipe.

2. Reducing Branch Connections: All reducing tee connections to steel pipe where the branch pipe is 3" or smaller shall utilize a reinforced welded connection fitting. Welded connection fitting shall be standard weight with male NPT thredolet outlet conforming to ASTM A105. A mitered branch with a saddle, reinforcing pad, or collar plate configuration will not be acceptable. Larger tee or wye connections shall be reinforced with collar plates, "donuts" or equivalent, as required by manufacturer for the maximum required operating pressures.

E. Corrosion Protection:

1. Coatings: Interior pipe, joints and fittings shall have corrosion protection coating as specified in Section 09 90 00 of these specifications.

2. Linings for Steel Pipe and Fittings: Except where galvanized pipe is allowed, steel pipe linings shall be liquid epoxy in accordance with AWWA C210 and Section 09 90 00 of these specifications. Linings shall be NSF approved for potable water use. All interior fittings and pipe shall be of the same lining system.

3. Field Repair: Any damaged coatings or linings shall be field repaired following the appropriate AWWA standard.

2.3 PVC PIPE

A. PVC pipe shall be used where indicated on the drawings or required by the specifications. All PVC pipe shall conform to the following standards:

1. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

2. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.

3. ASTM D2466, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

4. ASTM D2467, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

5. ASTM D2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

6. ASTM D2665, Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

7. ASTM D3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

8. ASTM D3035, Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

9. ASTM D3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

10. ASTM D3212, Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

11. ASTM D3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

12. ASTM F441/F441M, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

13. ASTM F477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

14. ASTM F1336, Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings.

B. Manufacturers: Provide products manufactured by one of the following pre-approved vendors:

1. Ipex, Inc.

2. Spears Manufacturing Company.

3. “Or Equal” products are acceptable with Engineers approval.

C. Material: Unless otherwise specified, comply with the following:

1. Type and Grade: Type 1, Grade 1.

2. Wall Thickness: Schedule 80 complying with ASTM D1784 and ASTM D1785, and US Product Service PS 21-70 as having same outside diameter dimension as cast-iron pipe.

3. Temperature Rating: Rated for temperature to 140 degrees F.

4. Color: Gray.

D. Fittings: Type, grade, schedule, and color of fitting shall match the associated pipe.

1. Solvent Weld: Comply with ASTM D2467.

2. Threaded: Threaded fittings shall comply with ASTM D2464.

3. Flanged: Provide flanged fittings with Neoprene gaskets.

E. Joints:

1. Solvent Weld: Use primer and solvent cement recommended by PVC pipe manufacturer for the application. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.

2. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe 1.5” and larger shall not be threaded.

3. Flanged: Provide with backup flange minimum 1/8-inch thick. Backup flanges and connecting bolts shall be Type 304 stainless steel.

2.4 PIPE HANGERS & SUPPORTS:

A. General: The CONTRACTOR shall be responsible for providing hangers and supports for all interior piping. Unless otherwise indicated, all pipe supports shall be standard, commercially accepted pipe supports and accessories. In locations where a standard support cannot be used, the CONTRACTOR shall be responsible for fabricating these supports in accordance with the details provided in the Drawings. Support spacing shall be as indicated on the drawings. Where no spacing is indicated, CONTRACTOR shall provide adequate support to eliminate all sagging in the pipe, to eliminate all dead loads on equipment or tank flanges, and/or movement of the pipe when subjected to the operating flow and pressure of the transported fluid.

B. Adjustable Pipe Stands Floor Supports: Pipe stands shall be ITT Grinnell Figure 259 pipe stands with U-bolt strap with Figure 62 adjustable pipe stanchions, or approved equals.

C. Wall Hangers & Supports: For pipes 1" in diameter or less, use Unistrut Corporation J1205N through J1220N, or approved equal. Where larger piping is supported from the wall, a wall support and "U" bolt shall be installed. The wall support shall be Figure 195 or 199 as manufactured by ITT Grinnell, or approved equal.

1. Small diameter pipe supports for attachment of 1” to 3” diameter pipe to walls shall consist of all-purpose metal framing. Metal framing shall be 1-5/8” square and constructed of hot-dipped galvanized steel, as manufactured by Unistrut. Pipe straps shall be Unistrut Series P2558 of the appropriate size, or approved equal. Support spacing shall be as indicated on the Drawings. Where no spacing is indicated, CONTRACTOR shall provide adequate support to eliminate all sagging in the pipe and/or movement of the pipe when subjected to the operating flow and pressure of the transported fluid.

D. Solid Wall, Ceiling or Floor Anchor Bolts: Anchor bolts used to attach structural steel support brackets in solid masonry or concrete ceilings, walls and floors shall have an externally threaded stud with a full length expanding sleeve as manufactured by Hilti, or approved equal. Anchor bolts shall be stainless steel and shall be installed per manufacturer's recommendations. Minimum size and depths of embedment shall be as indicated in the Drawing details for the specific use.

E. Hollow Wall Anchor Bolts: Anchor bolts for attachment of structural steel support brackets in hollow masonry walls shall be sleeve anchor type as manufactured by Hilti, or approved equal. Anchor bolts shall be 3/8" stainless steel and shall be installed according to the manufacturer's recommendations. Minimum depths of embedment shall be 1½".

F. Corrosion Protection: All new fabricated metal supports shall be painted for corrosion protection as specified in Section 09 90 00.

G. Discrepancies: Where discrepancies between the drawings and the specifications are discovered, the specifications shall prevail.

2.5 WALL & FLOOR PENETRATION SEALS:

A. Cored concrete wall and floor penetrations shall be sealed with Link-Seal penetration seals, or equal, per the detail in the Drawings. All bolts and nuts shall be stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: All steel pipe installation shall conform to the standards of AWWA Manual M11. Pipe runs shall be installed where indicated in the Drawings if the piping is dimensioned. Where piping is not dimensioned the CONTRACTOR shall install the pipe as close as possible to the locations indicated, taking care to maintain a neat appearance. Anchor pipe securely to building structure where indicated or required.

B. Fabrication: Pipe shall be accurately cut to the required lengths using tools specifically designed for the material involved. All piping shall be reamed to full size after cutting.

1. Changes in directions and intersection of lines shall be made with fabricated fittings. All manifolds, header pipes and unique joint and penetration configurations shall be shop fabricated. Mitering of pipe to form elbows, notching of straight runs to form toes, or any similar construction will not be permitted.

C. Assembly:

1. Flanged Joints: Thoroughly clean gasket and all surfaces that will contact gasket and thoroughly brush with soapy water. The faces of the flanges must be entirely free of sand, grit, grease and other foreign matter. Tighten bolts alternately and evenly to the torque required to generate the specific bolt preload recommended by the manufacturer, calculated using the formula:

$$T(ft-lb) = \frac{K \cdot D \cdot W}{12 \cdot N}$$

where K = nut factor, D = bolt diam. (in), W = total design bolt load (lb), and n = number of bolts. Torquing shall be applied in four (4) total passes following a cross pattern on the first three passes, with each pass effecting a torque of 1/3, 2/3, and the total torque, respectively. The fourth and final pass shall also be at the full torque, with bolts tightened in a counterclockwise sequence. Ineffective sealing will require disassembly, inspection for defects and proper reassembly of joints.

2. Threads on pipes shall be carefully cut with proper thread dies and shall be smooth and continuous. Screwed joints shall be made up with Teflon tape or an approved lead-free thread lubricant for the service involved and applied to male threads only. Joints that are required to be backed off shall be entirely disjointed, the threads of both the pipe and fittings shall be cleaned, new Teflon tape applied, and the connection reassembled.

3. Dielectric unions or fittings shall be used between any two pipe materials of non-identical material.

D. Handling of Pipe and Accessories: All pipe furnished by the CONTRACTOR shall be delivered and distributed at the site by the CONTRACTOR. Pipe, fittings, and accessories shall be loaded and unloaded by lifting with hoists or by skidding to avoid shock or damage. Under no circumstances shall such material be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

1. In distributing the material at the site of the work, each piece shall be unloaded near the place where it is to be installed or in an acceptable storage area.

E. Protecting Pipe: Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. Before pipe installed under this contract will be accepted by the Owner, the CONTRACTOR shall remove all debris, earth, rocks or other foreign material from the pipe. At all times when pipe installation is not actually in progress, the open ends of pipe shall be closed by temporary plugs, caps, or other approved means.

F. Alignment & Grade: Horizontal piping runs shall be installed level unless otherwise indicated with a slope and vertical runs shall be accurately plumbed.

1. Drain Lines: Pitch interior and exterior at ¼" per foot minimum or as shown on the Drawings. Verify actual inverts, slopes, etc. prior to installation. Make all changes of direction and junctions with Y fittings and 1/8 bends.

G. Electrical Equipment Clearance: No piping shall be installed directly above electrical switchboards or panelboards nor within dedicated clearance spaces required by the National Electric Code.

3.2 TESTING AND CLEANING:

A. Clean and sterilize all water lines in accordance with Section 33 01 10.

1. NOTE: no chlorine should be allowed to reach the inlet of the NF skid. See NF skid manufacturer installation instructions for cleaning and testing of lines.

B. Hydro-test all piping per Section 33 05 05.

- END OF SECTION -

SECTION 40 11 11 VALVES AND ACTUATORS

PART 1 - GENERAL

1.1 Description:

A. This section includes materials, testing, and installation of manually operated valves, check valves, and process valves including gate, butterfly, knife gate, ball, eccentric plug, lubricated plug, hose bibbs, globe, angle, needle, diaphragm, check, pinch, solenoid, mud valves, and flap valves.

B. This section includes materials, testing, and installation of motorized actuators to be installed on existing butterfly valves at the facility.

1.2 Related Work Specified Elsewhere:

A. Process Equipment Coatings: 09 90 00

B. Hydrostatic Testing of Pressure Pipelines: 33 05 05

1.3 Submittals:

A. Submit manufacturer's catalog data and detail construction sheets showing all valve parts and describing by material of construction and specification (such as AISI, ASTM, SAE, or CDA). Identify each valve by tag number to which the catalog data and detail sheets pertain.

B. Show dimensions and orientation of valve actuators, as installed on the valves. Show location of internal stops for gear actuators.

C. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.

PART 2 - MATERIALS

2.1 General:

A. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.

B. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

2.2 Manual Valve Operators:

A. Provide lever or wrench operators for valves 6 inches and smaller. For larger valves, provide gear driven handwheels.

B. Provide handwheels or lever operators as indicated on the plans or elsewhere in the specifications. NOTE: this project includes the installation of operators on a significant number of existing valves. Refer to the valve list for details. Bray Series 70 electric operators (to fit existing Bray Series 31 Lug Butterfly valves) are pre-approved.

C. Design gear operators assuming the differential pressure across the plug or disc is equal to the test pressure of the connecting piping.

D. Gear operators shall be enclosed, oil lubricated, with seals provided on shafts to prevent entry of dirt and water into the operators. Gear operators shall have handwheels. The operators shall contain a dial indicating the position of the valve disc or plug.

E. Traveling nut and worm and gear actuators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 80 pounds on the handwheel or crank. Provide stop limiting devices in the actuators in the open and closed positions..

F. Self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B 427), accurately machine cut. The worm shall be hardened alloy steel (ASTM A 322, Grade G31400l; or ASTM A 148, Grade 105-85), with thread ground and polished. Support worm gear shaft at each end by ball or tapered roller bearings. The reduction gearing shall run in a proper lubricant.

G. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

2.3 Motorized Valve Actuators:

A. Provide motorized actuators for valves as indicated on the plans or elsewhere in the specifications. NOTE: this project includes the installation of actuators on a significant number of existing valves.

B. Electric actuators shall be Bray Series 70 to fit existing Bray Series 31 Lug Butterfly valves. Refer to the table below and valve list for details.

Quantity	Existing Valve Size	Existing Valve Model	New Actuator Model
24	3”	Series 31, Model #31-0300-11010-124 Butterfly Valve	Bray S70-006
1	6”	Series 31, Model #31-0300-11010-124 Butterfly Valve	Bray S70-008

C. Motor Power requirements:
   1. Voltage: 120 VAC
   2. Frequency: 60 Hz
   3. Phase: 1 pH

D. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Mechanical stainless steel travel stops shall be provided and located outside the actuator enclosure for ease of adjustment.

E. Travel switches shall be single pole, Double Throw (SPDT) Form C Type UL listed and CSA Approved 10A at 125 VAC.

F. Travel limit switches shall limit the actuator travel in both open and closed direction of travel.

G. Actuator travel limit switches shall be held in brackets for accurate and repeatable valve position feedback.

H. Auxiliary switches are required on each actuator to indicate travel position for remote customer control systems. All auxiliary switches shall be single pole, Double Throw (SPDT) Form C Type UL listed and CSA Approved 10A at 125 VAC.

I. Input signals shall be 4-20 mA.

J. Provide high visibility valve position indicator locally mounted on actuator.

K. Provide manual handwheel override for manual operation of valve.

2.4 Valve Tagging and Identification:

A. Provide permanent plastic or metal identifying valve tags with valve numbers matching the drawings.

2.5 Bolts and Nuts for Flanged Valves:

A. Bolts and nuts for flanged valve shall be as described in the piping specifications.

2.6 Gaskets for Flanges:

A. Gaskets for flanged end valves shall be as described in the piping specification.

2.7 Painting and Coating:

A. Valves and actuators shall be factory painted and/or coated meeting the specifications outlined in Section 09 90 00.

2.8 Packing, O-Rings, and Gaskets:

A. Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following non-asbestos materials and in compliance with NSF 61:

1. Teflon

2. Kevlar aramid fiber

3. Acrylic or aramid fiber bound by nitrile. products: Garlock "Bluegard", Klinger "Klingersil C4400", or equal

4. Buna-N (nitrile)

2.9 Valves:

A. Butterfly Valves

1. General Requirements:

a. Butterfly valves shall be wafer type, conforming to AWWA C504.

b. Minimum working differential pressure across the valve disc shall be 250 psi.

c. Velocity through open valves will be 10 fps.

d. Valve shafts shall be Type 316 stainless steel.

e. Valve shafts shall be stub shaft or one-piece units extending completely through the valve disc.

f. Materials of construction shall be as follows:

Component	Material	Specification
Body	Cast iron or ductile iron	ASTM A 48, Class 40; ASTM A 126, Class; or ASTM A 536, Grade 65-45-12
Exposed body, capscrews, bolts, nuts	Stainless steel	ASTM A 276, Type 316
Discs	Stainless steel	ASTM A 276, Type 316
Internal lining, body and disc	Buna-N or Teflon	
Valves shall be Bray or equal.		

2. Thrust Bearings for Butterfly Valves:

   a. Provide thrust bearings to hold the valve disc in the center of the valve seat.

   b. No bearings shall be mounted inside the valve body within the waterway.

   c. Do not use thrust bearings in which a metal bearing surface on the disc rubs in contact with an opposing metal surface on the inside of the body.

3. Corrosion-Resistant Materials in Butterfly Valves:

   a. Where AWWA C504 (Subsections 3.5, 3.6, and 3.7) requires "corrosion resistant" material, such material shall be Type 316 stainless steel.

B. Ball Valves:

1. Double Union PVC Ball Valves 3 Inches and Smaller:

   a. Thermoplastic ball valves for water and chemical service shall be rated at a pressure of 150 psi at a temperature of 105EF. Body, ball, and stem shall be PVC conforming to ASTM D 1784, Type 1, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown on the plans. Valves shall be as manufactured by Chemtrol, Hayward, R&G Sloan, or equal.

C. Check Valves:

1. PVC Ball Check Valves:

   a. PVC check valves, 4 inches and smaller, shall be constructed of PVC per ASTM D 1784, Type I, Grade 1. Ends shall be double union, socket welded. Seats shall be Viton. Valve shall have a pressure rating of 150 psi at a temperature of 75EF.

PART 3 - EXECUTION

3.1 Joints:

A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joints compound or Teflon tape to pipethreads before installing threaded valves. joints shall be watertight.

3.2 Installing Valves:

A. Install valves in horizontal runs of pipe having centerline elevations 4'-6" or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4'-6" and 6'-9" above the floor with their operating stems horizontal.

B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.3 Mounting Gear Operators:

A. The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment. For existing valves, the Contractor shall install the actuator per manufacturer’s instructions and verify all bolts are torqued per specifications. Verify smooth operation of the valve is possible with the handwheel and the actuator. If any hesitation is noted, verify valve to piping flange bolts are properly torqued (a common error is over-torqued bolts in lug style butterfly valves).

3.4 Field Installation of Gear Actuator:

A. Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

3.5 Valve Leakage Testing:

A. Test valves for leakage at the same time that the connecting pipelines are tested. See Section 33 05 05 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any valves and retest.

3.6 Valve Field Testing:

A. Operate manual valves through 10 full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. If valves stick or bind, repair or replace the valve and repeat the tests.

B. Gear actuators shall operate valves from full open to full close through 10 cycles without binding or sticking. The pull required to operate handwheel - or chainwheel - operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

- END OF SECTION -

SECTION 40 90 00 - PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all Process Control and Instrumentation Systems (PCIS) complete and operable, in accordance with the Contract Documents.

B. The requirements of this Section apply to all components of the PCIS, unless indicated otherwise.

C. Responsibilities

1 The CONTRACTOR shall coordinate with the OWNER provided SYSTEM INTEGRATOR for the implementation of the PCIS and the integration of the PCIS with other required instrumentation and control devices.

2 Due to the complexities associated with the interfacing of numerous control system devices, the OWNER has hired a SYSTEM INTEGRATOR who is responsible for the integration of the CONTRATOR provided PCIS and other devices provided under other sections, with the objective of providing a completely integrated control system free of signal incompatibilities.

3 As a minimum, the SYSTEM INTEGRATOR shall perform the following WORK:

a Fabricate and program the Water Treatment Control Panel (WTCP).

b Deliver the WTCP to the job site for installation by the CONTRACTOR.

c Provide start-up, testing and commissioning of the PCIS including:

i oversee, document, and certify loop testing of the WTCP

ii configure and certify operation of the local area network (LAN).

iii Confirm proper communications between the WTCP, the nanofiltration control panel, the OWNER's desktop PC, the remote access gateway and the fiber optic internet service.

iv Perform subsystem testing including the automatic filtration process, nanofiltration process (coordinated with the nanofiltration supplier) and remote gateway SCADA access.

v Provide OWNER training.

4 As a minimum, the CONTRACTOR shall perform the following WORK:

a Receive and install the SYSTEM INTEGRATOR furnished WTCP.

b Receive and install the OWNER furnished nanofiltration system.

c Provide all other instrumentation, motor operated valves, motor starters, switches and other equipment as required by the contract documents.

d Coordinate with the OWNER and local utility for the installation of the fiber optic internet service.

e Provide all conduit, wiring, connectors and terminations required to interconnect the WTCP, nanofiltration control panel, internet service, OWNER's desktop and all field devices including instrumentation, motor operated valves, motor starters, switches and other equipment.

f Calibrate and configure all instrumentation and field devices.

g Provide assistance and coordinate with the SYSTEM INTEGRATOR and the nanofiltration system supplier as required to complete the loop testing, system start-up and testing.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittal Procedures and the following:

1 The CONTRACTOR shall coordinate the instrumentation work so that the complete instrumentation and control system will be provided and will be supported by accurate Shop Drawings and record drawings.

2 Exchange of Technical Information: During the period of preparation of these submittals, the CONTRACTOR shall authorize a direct, informal liaison with the ENGINEER for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as indicated may be authorized informally by the ENGINEER, but will not alter the scope of work or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the ENGINEER shall be construed to give approval of any component or method, nor shall any statement be construed to grant exception to or variation from these Contract Documents.

3 Symbology and Nomenclature: In these Contract Documents, all systems, all meters, all instruments, and all other elements are represented schematically, and are designated by symbology as derived from Instrument Society of America Standard ANSI/ISA S5.1 – Instrumentation Symbols and Identification. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, and similar materials. No other symbols, designations, or nomenclature unique to the manufacturer's standard methods shall replace those prescribed above, used herein, or on the Drawings.

B. Shop Drawings

1 General

a Shop Drawings shall include the letterhead or title block of the CONTRACTOR. The title block shall include, as a minimum, the CONTRACTOR's registered business name and address, project name, drawing name, revision level, and

personnel responsible for the content of the drawing. The quantity of submittal sets shall be as indicated in Section 01 33 00 – Contractor Submittal Procedures.

b Organization of the Shop Drawing submittals shall be compatible with eventual submittals for later inclusion in the Technical Manual.

c Shop Drawing information shall be bound in standard size, three-ring, loose-leaf, vinyl plastic, hard cover binders suitable for bookshelf storage. One set of drawings for each facility is to be hung inside the control panel. The drawings are to be enclosed in PVC pockets suitable for hanging from a 3-ring binder, two drawings per pocket. The ring binder is to be attached to the inside of the front panel door.

d Interfaces between instruments, motor starters, control valves, variable speed drives, flow meters, chemical feeders and other equipment related to the PCIS shall be included in the Shop Drawing submittal.

2 Hardware Submittal: The CONTRACTOR shall submit a hardware submittal as a complete bound package at one time within 60 calendar days after the commencement date stated in the Notice to Proceed, including:

a A complete index which lists each device by tag number, type, and manufacturer. A separate technical brochure or bulletin shall be included with each instrument data sheet (original documents only – photocopies are not acceptable and will be rejected). The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.

b Fully executed data sheets according to ISA-S20 – Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, for each component, together with a technical product brochure or bulletin. The technical product brochures shall be complete enough to verify conformance to all Contract Document requirements. The data sheets, as a minimum, shall show:

i Component functional description used in the Contract Documents
ii Manufacturer's model number or other product designation
iii Project tag number used in the Contract Documents
iv Project system or loop of which the component is a part
v Project location or assembly at which the component is to be installed
vi Input and output characteristics
vii Scale, range, units, and multiplier (if any)
viii Requirements for electric supply (if any)
ix Requirements for air supply (if any)

x Materials of component parts to be in contact with or otherwise exposed to process media and corrosive ambient air
xi Special requirements or features

c Priced list of all spare parts for all devices.

d Instrument installation, mounting, and anchoring details shall be submitted in an electronic hard copy format. Each instrument shall have a dedicated 8-1/2-inch by 11-inch detail which only pertains to the specific instrument by tag number. Each detail shall be certified by the instrument manufacturer that the proposed installation is in accordance with the instrument manufacturer's recommendations and is fully warrantable. These certifications shall be embedded in the CAD files and also appear as a stamp on the hard copies. As a minimum, each detail shall have the following contents:

i Show all necessary sections and elevation views required to define instrument location by referencing tank, building or equipment names and numbers, and geographical qualities such as north, south, east, west, basement, first floor.
ii Process line pipe or tank size, service and material.
iii Process tap elevation and location.
iv Upstream and downstream straight pipe lengths between instrument installation and pipe fittings and valves.
v Routing of tubing and identification of supports.
vi Mounting brackets, stands, and anchoring devices.
vii Conduit entry size, number, location, and delineation between power and signal.
viii NEMA ratings of enclosures and all components.
ix Clearances required for instrument servicing.
x List itemizing all manufacturer makes, model numbers, quantities, lengths required, and materials of each item required to support the implementation of the detail.

C. Technical Manual

1 General: Information in the Technical Manual shall be based upon the approved Shop Drawing submittals as modified for conditions encountered in the field during the WORK.

2 The Technical Manual shall have the following organization for each process:

a Section A – Edited As Built Drawings

b Section B – Instrument Summary

c Section C – Instrument Data Sheets

d Section D – Instrument Installation Details

e Section E – Test Results

3 Signed results from Loop Testing and the Final Acceptance Testing (FAT) report.

4 Initially, two sets of draft Technical Manuals shall be submitted for review after return of favorably reviewed Shop Drawings and data required herein. Following the ENGINEER's review, one set will be returned to the CONTRACTOR with comments. The Manuals shall be revised and amended as required and the final Manuals shall be submitted 15 days prior to start-up of systems.

5 The CONTRACTOR shall provide an Instrument Equipment Summary Form for all instruments, devices, control hardware, and miscellaneous equipment in accordance with Section 01 33 00 – Contractor Submittal Procedures and the Special Provisions. The data shall be provided in electronic format, **Microsoft Excel**, or approved equal.

D. Record Drawings

1 The CONTRACTOR in coordination with the SYSTEM INTEGRATOR shall keep current a set of complete loop and schematic diagrams which shall include all field and panel wiring, piping and tubing runs, routing, mounting details, point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and instrument elements. Two sets of drawings electronically formatted in AUTOCAD on CD-ROM and two hard copies shall be submitted after completion of all commissioning tasks. All such drawings shall be submitted for review prior to acceptance of the completed work by the OWNER.

1.3 WARRANTY

A. The warranty shall start from the date of final acceptance of the completed project, and shall extend for 1 year.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Code and Regulatory Compliance: PCIS WORK shall conform to or exceed the applicable requirements of the National Electrical Code and local building codes.

B. Current Technology: 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 required to match existing equipment.

C. Hardware Commonality: Instruments which utilize a common measurement principle (for example, d/p cells, pressure transmitters, level transmitters which monitor hydrostatic head) shall be furnished by a single manufacturer. Panel-mounted instruments shall have matching style and general appearance. Instruments performing

similar functions shall be of the same type, model, or class, and shall be from a single manufacturer.

D. Loop Accuracy: The accuracy of each instrumentation system or loop shall be determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of plus and minus 2 percent of full scale and a minimum repeatability of plus and minus 1 percent of full scale when installed in the field, unless otherwise indicated. Instruments that do not conform to or improve upon these criteria are not acceptable.

E. Instrument and Loop Power: Power requirements and input/output connections for all components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of "2-wire" transmitters is preferred, and use of "4-wire" transmitters shall be minimized. Individual loop or redundant power supplies shall be provided as required by the manufacturer's instrument load characteristics to ensure sufficient power to each loop component. Power supplies shall be mounted within control panels or in the field at the point of application.

F. Loop Isolators and Converters: Signal isolators shall be provided as required to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wirewound resistors shall be installed at all field side terminations in the control panels to ensure loop integrity. Signal conditioners and converters shall be provided where required to resolve any signal level incompatibilities or provide required functions.

G. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. The CONTRACTOR shall provide power wiring for these devices. Enclosures suitable for the environment shall be furnished. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

H. Signal Levels: Analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable. Electrical signals outside control panels shall be 4 to 20 mA DC, except as indicated. Signals within enclosures may be 1-5 VDC. Electric signals shall be electrically or optically isolated from other signals. Pneumatic signals shall be 3 to 15 psig, with 3 psig equal to 0 percent, and 15 psig equal to 100 percent.

I. Alternative Equipment and Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the ENGINEER through the "or equal" process of Section 01 25 00 – Products, Materials, Equipment

and Substitutions. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available. To match existing equipment and future equipment being installed under other contracts, equipment substitutions for equipment specified as no equal will not be accepted.

J. Instrument Brackets and Mounting Hardware: All instrument brackets and mounting hardware shall be stainless steel.

2.2 OPERATING CONDITIONS

A. The PCIS shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:

1	Environment	-	water treatment/supply facility
2	Indoor Temperature Range	-	32 through 84 degrees F
3	Relative Humidity	-	20 through 90 percent, non-condensing

2.3 SPARE PARTS AND SPECIAL TOOLS

A. The CONTRACTOR shall furnish a priced list of all special tools required to calibrate and maintain the instrumentation provided under the Contract Documents. After approval, the CONTRACTOR shall furnish tools on that list.

B. Special tools and spare parts shall be submitted before startup commences, suitably wrapped and identified.

PART 3 -- EXECUTION

3.1 PRODUCT HANDLING

A. Special Instructions: Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

B. Tagging: Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel tag firmly attached and stamped with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the PCIS. Identification shall be prominently displayed on the outside of the package.

C. Storage: Equipment shall not be stored outdoors. Equipment shall be stored in dry, permanent shelters, including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR. If any apparatus has been subject to possible injury by

water, it shall be thoroughly dried out and put through tests as directed by the ENGINEER. If such tests reveal defects, the equipment shall be replaced.

3.2 INSTALLATION

A. General

1 Instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 40 and the manufacturers' instructions.

2 Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the OWNER exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the CONTRACTOR shall make such changes without additional cost to the OWNER.

B. Conduit, Cables, and Field Wiring

1 Conduit shall be provided under Division 26.

2 Process equipment control wiring, 4-20 mA signal circuits, signal wiring to field instruments, PLC input and output wiring and other field wiring and cables shall be provided under Division 26.

3 Communication networks shall be provided under Division 26.

4 Terminations and wire identification at PCIS equipment furnished under this or any other Division shall be provided under Division 26.

C. Instrumentation Tie-Downs: Instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements applicable to the Site.

D. Existing Instrumentation: Each existing instrument to be removed and reinstalled shall be cleaned, reconditioned, and recalibrated by an authorized service facility of the instrument manufacturer. The CONTRACTOR shall provide certification of this work prior to reinstallation of each instrument.

E. Ancillary Devices: The Contract Documents show all necessary conduit and instruments required to make a complete instrumentation system. The CONTRACTOR shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements. Such additions and such changes, including the proposed method of installation, shall be submitted to the ENGINEER for approval prior to commencing the WORK. Such changes shall not be a basis of claims for extra work or delay.

F. Installation Criteria and Validation: Field-mounted components and assemblies shall be installed and connected according to the requirements below:

1 Installation personnel have been instructed on installation requirements of the Contract Documents.

2 Technical assistance is available to installation personnel at least by telephone.

3 Installation personnel have at least one copy of the approved Shop Drawings and data.

4 Instrument process sensing lines shall be installed under Section 40 23 12 – Piping and Tubing.

5 Flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.

6 Power and signal wires shall be terminated with crimped type lugs.

7 Connectors shall be, as a minimum, watertight.

8 Wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.

9 Wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices, unless specifically approved by the ENGINEER. Wiring shall be protected from sharp edges and corners.

10 Mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.

11 Verify the correctness of each installation, including polarity of electric power and signal connections, and make sure process connections are free of leaks. The CONTRACTOR shall certify in writing that discrepancies have been corrected for each loop or system checked out.

12 The OWNER will not be responsible for any additional cost of rework attributable to actions of the CONTRACTOR or the SYSTEM INTEGRATOR.

3.3 CALIBRATION

A. General: Devices provided under Division 40 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Calibration Points: Each instrument shall be calibrated at 25, 50, 75 and 100 percent of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Testing Standards.

C. Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the ENGINEER.

D. Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers.

F. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:

1 Project name

2 Loop number

3 Tag number

4 Manufacturer

5 Model number

6 Serial number

7 Calibration range

8 Calibration data: Input, output, and error at 25 percent, 50 percent, 75 percent and 100 percent of span

9 Switch setting, contact action, and deadband for discrete elements

10 Space for comments

11 Space for sign-off by CONTRACTOR and date

12 Test equipment used and associated serial numbers

G. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the ENGINEER. The CONTRACTOR shall have the SYSTEM INTEGRATOR sign the tag when calibration is complete. The ENGINEER will sign the tag when the calibration and testing has been accepted.

3.4 LOOP TESTING

A. The CONTRACTOR shall coordinate with and assist the SYSTEM INTEGRATOR and nanofiltration system supplier as necessary to complete the various control panel loop testing.

B. Control Valve Tests: Control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to insure that no changes have occurred since the bench calibration.

C. Instrument and Instrument Component Validation: Each instrument shall be field-tested, inspected, and adjusted to its indicated performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the ENGINEER and at the CONTRACTOR’s expense.

D. Loop Validation: Controllers and electronic function modules shall be field-tested and exercised to demonstrate correct operation of the hardware and wiring. Control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses at register in the PLC processor. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested.

E. Loop Validation Sheets: The CONTRACTOR shall prepare loop confirmation sheets for each loop covering each active instrumentation and control device including simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the SYSTEM INTEGRATOR:

1 Project name

2 Loop number

3 Tag number, description, manufacturer and model number for each element

4 Installation bulletin number

5 Specification sheet number

6 Adjustment check

7 Space for comments

8 Space for loop sign-off by SYSTEM INTEGRATOR and date

9 Space for ENGINEER witness signature and date

F. Loop Certifications: When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of each test form signed by the ENGINEER or the ENGINEER's representative as a witness, with test data entered, shall be submitted to the ENGINEER together with a clear and unequivocal statement that the instrumentation has been successfully calibrated, inspected, and tested.

3.5 PERFORMANCE TEST

A. The CONTRACTOR shall assist and coordinate with the SYSTEM INTEGRATOR during the complete start-up, testing and commissioning process. The CONTRACTOR shall provide the proper qualified personnel to make adjustments, assist with troubleshooting, provide technical support, etc. as necessary during the commissioning process.

B. The entire PCIS hardware, field instruments, power supplies, and wiring shall operate for 30 days without failure.

C. The CONTRACTOR shall furnish support staff as required to satisfy the repair or replacement requirements.

D. If any component, other than field instruments, fails during the performance test, it shall be repaired or replaced and the PCIS shall be restarted for another 30-day period.

3.6 REQUIREMENTS FOR SUBSTANTIAL COMPLETION

A. For the purpose of this Section, the following shall be fulfilled before the WORK is considered substantially complete:

1 Submittals have been completed and approved.

2 The PCIS has been installed, calibrated, and loop tested.

3 Spare parts and expendable supplies and test equipment have been delivered to the ENGINEER.

4 The performance test has been successfully completed.

5 Punch-list items have been corrected.

6 Record drawings in both hard copy and electronic format have been submitted.

7 Revisions to the Technical Manuals that may have resulted from the field tests have been made and reviewed.

8 Debris associated with installation of instrumentation has been removed.

9 Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

10 Instrument Equipment Summary Forms have been accepted by the OWNER.

END OF SECTION

SECTION 46 07 13 - NANOFILTRATION EQUIPMENT PACKAGE

PART 1 -- GENERAL

1.1 BASIS OF DESIGN

A. This specification covers the supply of a nanofiltration membrane system to be purchased by the OWNER and installed by the CONTRACTOR.

B. The NF system shall be rated for 60 gpm feed flow. The system shall be supplied in the following configuration:

1. Skid mounted equipment with little or no items shipped separately or off-skid. The equipment will be installed by the CONTRACTOR inside a modified storage area approximately 9'8" wide by 48' long. To facilitate the installation of other required items, the main NF skid will have size restraints in effect as follows:

(a) Option A: all equipment must fit within a 6' tall x 6' wide x 40' long area.

(b) Option B: all equipment must fit within an 8' tall x 6' wide x 20' long area.

2. All related equipment supplied by the NF system supplier shall fit within the space provided in 1 above, excluding an area 20' long by 3' wide reserved for electrical panels (see conceptual layout drawings for additional information).

1.2 GENERAL REQUIREMENTS

A. This item covers the work necessary to furnish and install equipment for a nanofiltration treatment system. The nanofiltration water treatment system shall perform all functions described in the specifications and normally associated with equipment of this type and character.

B. The nanofiltration (NF) equipment shall be assembled on a skid, pre-piped and pre-wired, requiring only final connections to be made prior to start up. Generally, this item includes all the components specified to be mounted on the NF equipment skid such as: membrane pressure vessels, cartridge pre-filters, a CIP tank, cleaning equipment with cleaning solution pumps and controls, and feed pump(s). The CIP pump is to be mounted on the NF skid. The main control panel should be mounted on the skid; however, owner will accept remote panel mounting for non-containerized systems.

C. The system specified herein shall be the end product of one NF equipment supplier and like items of equipment shall be the product of one manufacturer to achieve standardization of performance, operation, spare parts, maintenance, and manufacturer's warrantee and service.

D. It is the intent of these specifications and accompanying drawings to require the Contractor to provide and install one (1) nanofiltration skid system complete with all necessary instrumentation and controls with all required interconnecting piping. The omission of any items from these specifications shall not relieve the Contractor of responsibility for providing a complete and functional system.

E. The equipment supplier shall provide services for start-up, certification of the installation of the equipment for warranty and guarantees, training the City's

operating personnel, and placing the equipment in operation. The field service engineer shall have certification for commissioning and operating NF equipment. The contractor shall submit the credentials or the resume of the field engineer at least 30 days prior to starting up the equipment.

F. The Nanofiltration equipment supplier shall:

1. Have been in business manufacturing similar NF equipment for a period of not less than five (5) years.
2. Have built at least ten (10) NF units having product water capacity of at least 100 gallons per minute which are currently in use.

G. Connections of NF equipment to piping and wiring installed by the Contractor.

1. The NF equipment supplier shall provide piping connections to connect to feed water, product water (permeate) and drain water (concentrate) piping provided by and installed by the CONTRACTOR. Final connection of feed water, product water and drain water on the NF treatment unit will be done by the CONTRACTOR in the locations shown on the plans with flanged connections. If the NF system is shipped on more than one skid it is the responsibility of the CONTRACTOR to make all connections between vendor provided skids or any items provided or shipped loose.
2. A High Pressure NF booster pump shall be mounted on the skid. Skid design with high pressure pump not mounted on the skid WILL NOT be accepted.
3. Wiring and conduits for electrical power supply and controls interface to the treatment plant SCADA system shall be furnished and installed by the CONTRACTOR under Division 26 to the NF control panel. Final connections at the NF control panel shall be made by the CONTRACTOR under the supervision of the NF equipment supplier. All connections between instruments, valves, motors, etc. mounted on the skid shall be factory wired to the control panel or to a common terminal box for remote mounted panels.
4. Controls for Antiscalant and/or Sodium bisulfite feed pumps (if required – the current system does not inject chlorine upstream of the NF unit) shall be the responsibility of the NF equipment supplier and shall controlled by the NF skid PLC.
5. The CONTRACTOR and NF equipment supplier shall coordinate checkout of wiring and control interfaces in their respective panels during startup.

1.3 SUBMITTALS

A. Shop Drawing Submittals

1. Complete shop drawings, details and specifications for the equipment shall be submitted for review before the equipment is released for production by the supplier.
2. It is the CONTRACTOR’s responsibility to make sure the equipment proposed by NF equipment supplier meets the specifications. The NF supplier must bring to the attention of the CONTRACTOR any changes to the specification or the dimensional requirement of the NF equipment skid prior to the bid. These

changes, if not approved by the ENGINEER prior to the bid, will not be acceptable during shop drawing review phase of the project.

3. Shop Drawing submittal shall include:
   (a) General arrangement and installation drawings.
   (b) Wiring and schematic diagrams.
   (c) Specifications and data on the materials used, including NSF certifications. Specification of all equipment used on the skid.
   (d) Electrical - control panel drawings and details, dimensions, metal thickness, device arrangement inside panel, painting.
   (e) Piping - hydraulic data, pipe specifications and pressure ratings.
   (f) Process and control data on gauges, meters, instruments and regulating valves.
   (g) Specification on Membrane proposed.
   (h) High pressure pumps performance data, curves.
   (i) CIP/Permeate feed pump performance data, curves.
   (j) Logic diagrams for electrical and electronic control systems.
   (k) Drawing defining terminal points of piping and wiring connections to items provided by the Contractor.
   (l) Flow control system sequence on start-up and shut-down, alarm shut-downs, and automatic flushing functions.
   (m) List of recommended spare parts.
   (n) Recommended storage procedures.
   (o) Performance test procedures.
   (p) Blank Daily Monitoring log sheet.
   (q) Written description of control system.
   (r) Calculations for pre-filters, flux, and water velocities.
4. Additional items to be included: (list of model numbers and brand names of all major components including)
   (a) Nanofiltration membrane elements
   (b) Pre-filters (housing and cartridge)
   (c) Membrane pressure vessels
   (d) CIP tank
   (e) Control panel
   (f) Programmable controllers and Operator Interface Terminal (OIT)
   (g) pH and conductivity monitors
   (h) High pressure pumps, CIP pump
   (i) Flow monitors

(j) ORP analyzer and monitor

(k) Automatically controlled valves and actuators.

1.4 DESIGN

A. Water Supply:

1. The City of Thorne Bay will supply filtered surface water to the NF skid inlet through existing multimedia filters rated for 60 gpm total flow. All interconnecting piping is the responsibility of the CONTRACTOR.

2. The feed source to the existing treatment plant is surface water from Water Lake. The feed source for the NF skid is the filtrate from the existing multimedia filters. No additional information on raw water quality will be provided. Any additional data required to complete the design must be collected by the equipment vendor.

B. Raw Water Quality

1. The water quality characteristics of the NF skid feed source are given below:

Test	**Units**	**Value**
Hardness (as $CaCO_3$)	mg/l	9.75 – 10
Iron (Total)	mg/l	No Data
Potassium	mg/l	No Data
Calcium	mg/l	No Data
Magnesium	mg/L	No Data
Sodium	mg/l	No Data
Silica	mg/l	No Data
Alkalinity, Total (as $CaCO_3$)	mg/l	32 – 33
Bicarbonate	mg/l	No Data
Chloride	mg/l	No Data
Fluoride	mg/l	0.05
pH	units	5.5 – 6.6
Sulfate	mg/l	No Data
Total Dissolved Solids	mg/l	38 – 60
Total Organic Carbon	mg/l	4 – 7
Temperature	°C	3.5 – 12.2
Turbidity	NTU	< 0.1
Color	PCU	< 5

C. Pretreatment

1. The NF supplier shall include connections for chemical injection points on the inlet piping to the NF system ahead of the cartridge pre-filters (if required).

2. Cartridge filters shall be provided by the NF manufacturer with pore rating to ensure membrane warrantee is maintained.

D. Post-Treatment

1. An existing chlorine injection point and soda ash injection point are located downstream of the NF skid (in existing piping) prior to the clearwell.
2. No additional post treatment connections are anticipated unless specifically required by the NF equipment manufacturer. If required, these shall be located in the permeate line prior to leaving the equipment skid.

1.5 NANOFILTRATION SYSTEM

A. Number of NF skids: One (1)

B. System design and performance per skid:
   1. Design recovery = 85%.
   2. Minimum time between membrane replacements: 5 years (targeted life 7 years)
   3. Minimum time between CIP events: 3 months (targeted time 6 months)
   4. Array configuration: by vendor
   5. Treatment Trains per skid: 1
   6. Maximum overall system flux: 16 GFD
   7. Design rates for each train:
      (a) feed flow = 60 GPM @ 40 psig, ahead of cartridge filters
      (b) permeate flow = 51 GPM
      (c) concentrate flow = 9 GPM
      (d) minimum permeate pressure = 37 psig
   8. Type of membrane: low-energy thin film composite (TFC) standard 8" x 40" spiral wound elements. FRP outer wrap NSF approved
   9. Minimum total organic carbon removal = 90%

C. Controls and Functions
   1. NF system control panel should be mounted on the skid (remote mounting optional, but not preferred). Panel and related electrical and control hardware and devices shall be U.L. 508A compliant and be duly marked. Panel shall bear the serialized U.L. 508A decal(s).
      (a) Panel enclosure NEMA 4/12
      (b) Power supply to panel will be 120 VAC.
      (c) Main disconnect on power supply. NEMA 4 enclosure.
      (d) NF equipment manufacturer shall include a VFD for the NF booster pump. VFD controllers shall be supplied in enclosures capable of dissipating the heat generated, mounted and wired on the NF skid at the factory prior to shipment. Power supply to VFD panel will be 480 VAC, 3 phase.
      (e) Programmable logic controller (PLC) shall be Allen-Bradley CompactLogix processor. Operator Interface Terminal (OIT) shall be Allen-Bradley PanelView 1000+, color touchscreen, with Ethernet communication. The NF

control system shall manage; start-stop of NF and interconnected equipment, sequencing, fault shutdowns and alarms. Uninterruptible power supply (UPS) shall be provided for the PLC and shall keep the PLC operational for at least 10 minutes. High pressure pumps shall be on VFD's as specified.

(f) Input-output signals to control membrane treatment feed pump and chemical feeders.

(g) Instrumentation for monitoring NF

(h) Electrical components shall conform to Division 26 - Electrical.

(i) Elapsed timer to totalize operating time for the NF system, reading hours and tenths of hours.

(j) All electrical equipment on the NF skid shall be NEMA 4 rated and shall be rated UL.

2. Control Functions

(a) The NF train to have manual and automatic mode. Manual mode is to be used only for testing purposes, with operator present.

(b) In automatic mode the system is controlled by the PLC controller.

(c) Start-stop signal will be input to the NF control panel from the main control panel which is furnished under Division 26.

D. Monitoring

1. Measured process parameters: The process parameters to be measured for the NF are listed below. The nominal value of each of the process parameters is to be in accordance with nanofiltration manufacturer's recommendations. Each instrument to have sufficient range as designated by good design practice.

Instrument/Per Train	**Type**	**Location**	**Function**
Pressure	Gauge and Transducer	Before Cartridge Filter	Indicate and OIT Display
Pressure	Gauge and Transducer	After Cartridge Filter	Indicate and OIT Display
pH	Monitor	After Cartridge Filter	Indicate/Alarm Shut-down High/Low
Conductivity	Monitor	After Cartridge Filter	Indicate/Alarm Shut-down High/Low
ORP	Monitor	After Cartridge Filter	Indicate/Alarm Shut-down High
Temperature	Gauge	Before HP Pump	Indicate
Pressure	Switch	After cartridge filter, system concentrate outlet and permeate.	Display on OIT and Alarm/Shutdown Low
Pressure	Gauge and Transducer	After HP Pump	Indicate and display on OIT. Alarm/Shutdown High

Instrument/Per Train	Type	Location	Function
Pressure	Gauge and Transducer	After Pump Throttling Valve	Indicate and display on OIT. Alarm/Shutdown High
Pressure	Gauge (2 required) and Transducers (2 required)	Concentrate Outlet from First Stage & Second Stage	Indicate and Display on OIT.
Pressure	Gauge	System Concentrate Outlet	Indicate Outlet Concentrate Pressure
Flow	Meter	Permeate and Concentrate Outlets	Indicate/Totalize Feed, Permeate and Concentrate Flows
Conductivity	Monitor	Permeate Flow	Indicate/Alarm and Shut Down on High
Pressure/ Level	Transducer	CIP Tank	Monitor Tank Levels

E. Fault Shutdowns

1. NF system to shutdown on following faults:
   (a) High pH feed water and low pH feed water.
   (b) High pressure at NF feed pump outlets.
   (c) Low pressure switch trip on feed pump Feed and High Pressure switch trip on permeate and outlet concentrate pressures.
   (d) High feed temperature.
   (e) High alarm from ORP monitor.
   (f) Low Permeate and Concentrate Flow
2. Visual and audible alarms shall be provided on the panel for each of the above shutdowns and alarms. Provide indication on OIT for which system is under alarm.

1.6 FACTORY TESTING

A. Assembled NF system

1. The NF equipment supplier shall pressure test the NF equipment prior to shipment to check for leaks, operation of controls, valves, meters, gauges, pumps, and all other components mounted on the skid. Include machine test data logs in Operation & Maintenance manual.
2. All equipment shall be properly calibrated and adjusted as required to assure that it will start up and perform properly when installed at the water treatment plant.

B. Membrane Elements

1. Membrane elements shall be individually tested and marked with a permanent factory serial number.

2. A test report shall be submitted to the owner, with the following information for each element:

   Membrane serial number
   Date of Test
   Test conditions: Temperature, pressure, feed water composition, recovery
   Test results: Salt rejection, membrane productivity in gallons/day

1.7 WARRANTIES

A. The complete NF system shall be guaranteed per the general and supplemental conditions of the contract. Any equipment found to be defective in normal operation during the warranty period shall be replaced by the NF equipment supplier at no cost to the Owner.

B. The original manufacturer of the membrane elements shall provide to the Owner a three year prorated warranty covering defects in workmanship and materials of the membrane elements.

1.8 MANUFACTURERS

A. The following NF equipment manufacturers are pre-approved. Any other manufacturer will require approval by ENGINEER prior to bidding.
   1. Wigen Water Technologies, Chaska, MN
   2. Pure Aqua Inc, Santa Ana, CA
   3. H2OInnovation, Calgary AB Canada
   4. Koch Membrane Systems, Wilmington MA

PART 2 -- PRODUCTS

2.1 NANOFILTRATION EQUIPMENT

A. Cartridge Filters - NF prefilters
   1. Five (5) Micron, spun polypropylene cartridges, with integral compression end.
   2. Must have NSF 61 approval for potable water use.
   3. Maximum loading of **3.5** GPM per 10 inch equivalent length of cartridge element. NF supplier to select length and number of cartridges in each housing, and provide calculations with shop drawing submittals.
   4. Clean filter pressure drop not to exceed 4 psi at design flow.
   5. Housing - 304 stainless steel.
   6. Cover shall be a swing type, davit style, with a positive o-ring seal.
   7. Minimum of one (1) housing per treatment train.
   8. Each cartridge filter housing shall have isolation valves permitting the filters to be changed without draining the entire machine.

9. Each filter cartridge housing shall be provided with a valved drain line and an air bleed valve.
10. Pressure rating of housing 100 psig.
11. Housings shall be located on the front of the NF skid to facilitate convenient replacement of filter elements.
12. Pressure gauges on the common inlet and outlet to determine pressure drop through cartridge filters.
13. Housings shall be built to ASME code standards and SHALL NOT contain springs or special compression parts that are able to fall into the housings.

B. High Pressure Pumps
   1. Tonkaflo, Goulds, Grundfos, or approved equal.
   2. Multistage centrifugal, 316 stainless steel wetted components.
   3. Pumps (1):
      (a) Capacity = 60 GPM @ (vendor specified) psi T.D.H.
      (b) VFD rated motors per Division 26.
      (c) 3500 RPM
   4. Motor shall be 460 Volts, 3 phase, T.E.F.C., premium efficiency type.
   5. Pumps shall be provided with coupling, coupling guard, and base.
   6. Pump shall not overload the motor nameplate horsepower at any point in the complete operating range.
   7. Pumps shall be tested to demonstrate conformance to the specifications.

C. Nanofiltration Membrane System
   1. Pressure vessels (membrane housings)
      (a) Industry standard 4” or 8” FRP. Shall be constructed to ASME standards and shall be NSF 61 certified. Ports shall be sized for a maximum flow velocity of 10 fps and be 2.5” minimum size. Supplier shall provide velocity calculations with the shop drawings.
      (b) Room for a minimum of four (4) membrane elements in each vessel, 40 inch length standard elements.
      (c) Each vessel with two end closures with suitable retaining devices.
      (d) Fiberglass reinforced plastic (FRP) pressure vessels shall be Pentair (Codeline) or approved equal, conforming to ASME Code for Unfired Vessels, Section X., painted on the outside with light color white, high gloss polyurethane coating.
      (e) FRP pressure vessels shall have the following pressure ratings:
         (1) Design operating pressure = 300 psig at 120°F.
         (2) Factory test pressure = 600 psig.
         (3) Minimum burst pressure – 1,800 psig

(f) Stainless steel pressure vessels shall have the following pressure ratings:

(1) Design operating pressure = 300 psig

(2) Factory test pressure - 600 psig

(3) Minimum burst pressure - 1800 psig

(g) No more than one (1) pressure vessel shall be fed together through a single port.

2. Membrane elements

(a) Spiral wound, low-energy thin film composite (TFC).

(b) Industry standard 4.0 or 8.0 inches diameter, 40 inches length.

(c) Elements must be NSF 61 Approved.

(d) Total number of elements: By vendor.

D. Skid and Equipment Racks

1. NF unit, pumps, pressure vessels, piping, pre-filter cartridge housings, and all other components shall be factory assembled on a skid and supporting structure constructed of corrosion resistant materials.

2. NF skid and supporting structure shall be welded carbon steel, free of weld slag and finished with a baked, electrostatic powder coated material. Mounting hardware and fasteners shall be 304 or 316 stainless steel materials.

3. Skid Dimensions shall fit in the space available as outlined in section 1.1 A 2.

4. Instrument air is not available on site. All valves shall be electrically actuated and pre-wired or a suitable air system must be provided with the skid system.

5. Skid shall be attached to a concrete pad with stainless steel anchors, with provisions for leveling the skid before grouting.

E. Clean-In Place System (CIP)

1. The Clean-In Place (CIP) System shall be provided by the NF supplier. This system will consist of one (1), HDPE tank with heater of minimum 15 KW. The tank shall have Permeate and Concentrate return connections at the top and pump suction connection and 1" drain connection at the bottom of the tank. A CIP pump shall be provided on the NF system skid as specified in paragraph 6 below.

2. The CIP shall be designed to clean the NF system by train. Manual valves shall be placed on the ends of the concentrate and permeate piping to prevent flow while changing locations or during soaking operations.

3. The use of flexible hoses to connect CIP tank to NF skid WILL NOT be acceptable

4. Provide a grooved connection (Victaulic or equal) and removable pipe spool on the permeate to the treated reservoir, so that line can be physically disconnected during cleaning. This is to assure that no cleaning chemicals can be accidentally discharged to the treated water reservoir.

5. The CIP tank shall have the following instrumentation:

(a) Level Sensor/Transducer

(b) Temperature Switch

(c) Temperature Gauge

6. The CIP pump shall have all 316 stainless wetted parts. CIP pump shall be 460 volts, 3phase, 60 HZ and sized per Vendor standards.
7. PVC or CPVC pipes shall be used for the transport of fluids.
8. The discharge piping of the CIP pump shall contain a by-pass line with valves to run water through CIP pump and back to the tank, plus an additional by-pass line with eductor for feeding CIP chemicals into the tank.

2.2 PIPING, VALVES AND FITTINGS

A. Pressure Piping

1. 304 or 316 stainless steel, ASTM A312, piping shall be finished with acid dipped passivated welds.
2. Schedule 10S.
3. Assemblies shall be thoroughly cleaned inside and out, and all scale and welding slag removed.
4. 150 lb. class weld neck type flanges or grooved joints as required.

B. Low pressure piping

1. Schedule 80 PVC, type 1, ASTM D-1785.
2. NSF approved for potable water.
3. Socket joints, or flanged where required.
4. Supported in accordance with manufacturers recommendations, allowing for expansion and contraction.
5. Provide unions on either side of all non-flanged components for removal.
6. PVC flanges shall be ANSI B16.5, 150 lb.

C. Pipe sizes for the piping on the NF skid shall be determined by the NF system supplier.

1. Velocity based on piping manufacturer' recommendations and standards for each type of pipe. Velocity shall not exceed 10 fps.

D. Connections

1. NF systems supplier shall provide piping and fittings for making final connections to piping furnished by the Contractor. Final connections shall be flanges.
2. Provide sample ports for permeate from each pressure vessel.
3. Provide means for probing membranes permeate tubes in each vessel.
4. Provide PVDF injector that incorporates internal check valve for each chemical injection system connection at NF inlet piping.

5. Furnish unions or flanged connections on either side of all system components to permit removal.

E. Valves

1. Butterfly valves
   (a) Wafer style
   (b) Valve seat EPDM
   (c) Stainless steel shaft
   (d) Bray, to match existing equipment are preferred
2. Plastic ball valves
   (a) True union type
   (b) CPVC for chemical service, PVC for other services.
   (c) 150 psi service rating
   (d) Teflon seats and EPDM seals
   (e) ASAHI, Chemtrol, or equal.
3. Concentrate flow control valves
   (a) Suitable to control concentrate flow for operation of the system.
   (b) Valve to operate without cavitation at and rate of flow within the operating range.
   (c) Valve shall be 316 stainless steel v-ported ball valve, needle valves, or globe valve.
4. Valve Actuators
   (a) Electric actuators, Bray to match existing equipment are preferred.
   (b) Pneumatic actuators, if used, shall be sized to match Vendor provided air system.
   (c) All automatically controlled open/close valves shall be equipped with open and closed limit switches and shall be prewired to the control panel.
   (d) All automatically controlled valve actuators shall be from the same manufacturer.

2.3 INSTRUMENTATION

A. NF system supplier shall provide all instrumentation components mounted on the skid as specified, or required for proper monitoring of NF system operation.

B. Flow instrumentation

1. Flow indicators and totalizers shall be provided on the NF bank for concentrate and permeate flow.
   (a) Meters – Signet insertion type sensor with rotor, matched sensor installation fitting in the pipe, and digital indicator totalizer.

(b) Indictor reading in G.P.M. on a 4 digit LCD display, accuracy ±1% of full scale.

(c) Totalizer calculated on OIT, non-resettable display, 8 digit counter, in Gallons

(d) Indicator/totalizers mounted on the NF control panel.

(e) Meter size shall be selected so that the design flow will be in the upper 50% of the meter flow range.

(f) Upstream and downstream straight pipe lengths shall be as recommended by the meter manufacturer, or straightening vanes shall be provided.

C. Pressure Gauges

1. Minimum 4 inch diameter, stainless steel, liquid-filled gauges.
2. Pressure gauges shall be provided in the locations as listed in paragraph 1.04-C of this specification.
3. Pressure gauges shall be liquid filled, stainless steel case and internals.
4. Provide shutoff cocks on all pressure gauge connections, to allow removal and replacement of gauges while unit is operating.

D. Pressure Switch

1. Low pressure switch provided on inlet line to NF feed pump to shut down machine due to low pressure, after an adjustable time delay, and on Permeate and Concentrate lines to shut off machine due to high pressure, after adjustable time delay.
2. Switch shall be vibration free and not be part of a pressure gauge.
3. Externally field adjustable, with trip point repeatability of ±1% of actual pressure.

E. Pressure Transmitters

1. Pressure transmitters shall be true two-wire transmitters, providing 4-20 mAdc isolated output with a total load of up to 600 ohms, utilizing a remote power supply of 24 VDC over one wire pair. Accuracy, including linearity, hysteresis, and repeatability shall be ±0.5 percent of span. Twenty-turn potentiometer for zero and span adjustment screws shall be provided.
2. They shall be suited for operation in an ambient temperature range of -20º to +200ºF, 0 to 100 percent relative humidity, up to three "g" vibration.
3. All wetted parts shall be of stainless steel and Teflon. Pressure over-range of 1.5 times maximum span shall not cause an output shift greater than 0.05 percent and burst pressure shall be at least five times rated operating pressure. The unit shall be directly mounted on the process piping with a one-half inch manifold with supply and bleed valve.

F. pH Monitor

1. Provide panel mounted pH monitor on the feed line to the NF
2. pH sensor and transmitter shall be Endress+Hauser or Rosemount.
3. Corrosion resistant sensor.

4. Transmitter shall be LCD readout and have an isolated 4-20mA signal proportional to measured pH.
5. The transmitter signal shall activate an alarm and shut down NF system if pH is outside of the high or low set points.

G. Conductivity Monitor

1. Provide panel mounted conductivity transmitter on the permeate and feed lines on the NF.
2. Conductivity equipment shall be Endress+Hauser or Rosemount.
3. Corrosion resistant sensor construction.
4. Automatic temperature compensation.
5. Line mounted sensor.
6. Isolated 4-20mA signal proportional to measured conductivity.

H. Temperature

1. Provide line mounted thermometer to indicate temperature of feed water.

I. ORP Analyzer

1. Provide panel mounted ORP monitor on the feed line to the NF.
2. ORP sensor and transmitter shall be Endress+Hauser or Rosemount.
3. Corrosion resistant sensor.
4. Transmitter shall indicate and have an isolated 4-20 mA signal proportional to measured ORP.
5. The transmitter signal shall activate an alarm and shut down the NF system if the ORP is above the high set point.

2.4 ELECTRICAL

A. Equipment and materials shall conform to Division 26, Electrical.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions and recommendations.

B. CONTRACTOR is responsible for all interconnecting piping, tubing, air lines, and electrical connections to ensure a complete installation matching the intent of the drawings and specifications. NOTE: All bulk chemical containers shall be located inside the existing chemical room to minimize the volume of hazardous chemicals located in the NF filtration room.

C. The manufacturer's representative shall provide written certification that the equipment has been installed correctly prior to start-up of the NF equipment.

3.2 START-UP, TESTING AND TRAINING

A. The NF Equipment Supplier shall provide services of a qualified representative for a minimum of two (2) trips to the jobsite to load filters & membranes, commission the equipment, and train owner's operating personnel in proper operation, maintenance, and monitoring procedures. The combined time spent shall be not less than seven (7) 8-hour working days at the project site.

B. Following start-up and initial operation of the NF. system, the manufacturer's representative shall submit a report to the Owner with the following information:

1. Data showing compliance with specified performance.
2. Recommendations for proper chemical feed rates.
3. Recommended valve settings for flow control.

C. NF supplier shall provide enough antiscalant and bisulfite chemical (if required) for the first 90 days of operation as part of the base bid package. The City may then contract with the equipment supplier or another source for subsequent chemical purchases.

3.3 OPERATION AND MAINTENANCE MANUAL

A. The equipment manufacturer shall provide a complete operation and maintenance manual for the NF systems. Four (4) copies shall be provided to the Owner prior to start-up. The manual shall cover all components of the system, including information needed to order replacements parts, a list of recommended spare parts, and data sheets for the operator to use for record keeping of operating data.

3.4 SPARE PARTS

A. Include sufficient new cartridge filter elements for three (3) complete changes of cartridge filters for the NF. One (1) set installed and 3 additional sets for change out.

B. A list of all critical spare parts recommended to be carried in stock by the Owner shall be provided. The list shall include identification and price of all the recommended spare parts.

3.5 SILT DENSITY INDEX (SDI) TEST APPARATUS

A. Furnish with the NF equipment a manual SDI testing apparatus, including; 0.45 micron filter papers, filter holder, pressure reducing valve, shutoff valves, and tubing.

B. Provide sampling connections on the piping before and after the cartridge filters on the NF for SDI testing.

3.6 SAMPLE PROBE

A. The equipment supplier shall provide a sample probe with pre-measured markings for each membrane in a vessel and pressure fitting to sample the permeate from each membrane in a vessel.

- END OF SECTION -

SECTION 46 61 73 - AUTOMATIC STRAINER – SELF BACKWASHING FILTER SCREEN

PART 1 -- GENERAL

1.1 BASIS OF DESIGN

A. This specification covers the supply of a self-backwashing pre-filter screen.

1.2 GENERAL REQUIREMENTS

1. Supply one self-backwashing pre-filter screen with all associated equipment.
2. Operating pressure 60 psig, maximum normal flow 60 gpm, design flow 100 gpm, reject outlet to open drain (no backpressure).
3. Screen shall be 100 micron 316L stainless steel.
4. Housing shall be epoxy coated steel.
   (a) Amiad / Filtomat M103C or equal with 100 micron screen.

1.3 SUBMITTALS

A. Shop Drawing Submittals

1. Complete shop drawings, details and specifications for the equipment shall be submitted for review before the equipment is released for production by the supplier.
2. It is the CONTRACTOR's responsibility to make sure the equipment proposed meets the specifications. The supplier must bring to the attention of the CONTRACTOR any changes to the specification or the dimensional requirement of the equipment prior to the bid. These changes, if not approved by the ENGINEER prior to the bid, will not be acceptable during shop drawing review phase of the project.
3. Shop Drawing submittal shall include:
   (a) General arrangement and installation drawings.
   (b) Wiring and schematic diagrams.
   (c) Specifications and data on the materials used, including NSF certifications. Specification of all equipment used on the skid.
   (d) Drawing defining terminal points of piping and wiring connections to items provided by the Contractor.
   (e) List of recommended spare parts.

1.4 DESIGN

A. Water Supply:

1. The feed source to the existing treatment plant is surface water from Water Lake at 60 gpm. No additional information on raw water quality will be provided. Any additional data required to complete the design must be collected by the equipment vendor.

B. Raw Water Quality

1. The water quality characteristics of the NF skid feed source are given below:

Test	Units	Value
Hardness (as $CaCO_3$)	mg/l	9.75 – 10
Iron (Total)	mg/l	No Data
Potassium	mg/l	No Data
Calcium	mg/l	No Data
Magnesium	mg/L	No Data
Sodium	mg/l	No Data
Silica	mg/l	No Data
Alkalinity, Total (as $CaCO_3$)	mg/l	32 – 33
Bicarbonate	mg/l	No Data
Chloride	mg/l	No Data
Fluoride	mg/l	0.05
pH	units	5.5 – 6.6
Sulfate	mg/l	No Data
Total Dissolved Solids	mg/l	38 – 60
Total Organic Carbon	mg/l	4 – 7
Temperature	°C	3.5 – 12.2
Turbidity	NTU	< 0.1
Color	PCU	< 5

1.5 SCREEN

A. 100 micron stainless steel.

1.6 FACTORY TESTING

A. All typical factory tests to ensure full functionality prior to shipment.

1.7 WARRANTIES

A. The filter system shall be guaranteed per the general and supplemental conditions of the contract. Any equipment found to be defective in normal operation during the warranty period shall be replaced by the equipment supplier at no cost to the Owner.

1.8 MANUFACTURERS

A. The following equipment manufacturers are pre-approved. Any other manufacturer will require approval by ENGINEER prior to bidding.

1. Amiad / Filtomat

PART 2 -- PRODUCTS

2.1 EQUIPMENT

A. One hydraulically actuated self backwashing pre-filter.
   1. 100 micron 316 stainless steel weave wire screen.
   2. Epoxy coated carbon steel housing.
   3. PVC exhaust valve.
   4. BUNA-N seals.
   5. Automatic actuating valve and tubing all pre-installed and tested at the factory.

2.2 ELECTRICAL

A. Equipment and materials shall conform to Division 26, Electrical.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions and recommendations.

B. CONTRACTOR is responsible for all interconnecting piping, tubing, air lines, and electrical connections to ensure a complete installation matching the intent of the drawings and specifications.

3.2 START-UP, TESTING AND TRAINING

A. Manufacturer shall assign a start-up advisor and be available by phone for start-up and testing completed by the CONTRACTOR.

B. No on-site training is required for this item.

3.3 OPERATION AND MAINTENANCE MANUAL

A. The equipment manufacturer shall provide a complete operation and maintenance manual. Four (4) copies shall be provided to the Owner prior to start-up. The manual shall cover all components of the system, including information needed to order replacements parts, a list of recommended spare parts, and data sheets for the operator to use for record keeping of operating data.

3.4 SPARE PARTS

A. Per manufacturers recommendation.

- END OF SECTION -

SECTION 46 61 73 – AIR BLOWER – AIR ENHANCED BACKWASH EQUIPMENT

PART 1 -- GENERAL

1.1 BASIS OF DESIGN

A. This specification covers the supply of a rotary screw air blower package to provide low pressure air for enhanced backwash of the existing multi-media filters. Air provided shall be oil free; however, air drying is not required for this application.

1.2 GENERAL REQUIREMENTS

1. Supply one rotary screw air blower package and all associated equipment required to provide a minimum of 98 SCFM at 6 psig using a 460v / 60 hz / 3 ph power source. Pre-approved manufacturer / model is listed below and alternates are acceptable with engineers approval.

   (a) Kaeser BB52C.

1.3 SUBMITTALS

1. Complete shop drawings, details and specifications for the equipment shall be submitted for review before the equipment is released for production by the supplier.
2. It is the CONTRACTOR's responsibility to make sure the equipment proposed meets the specifications. The supplier must bring to the attention of the CONTRACTOR any changes to the specification or the dimensional requirement of the equipment prior to the bid. These changes, if not approved by the ENGINEER prior to the bid, will not be acceptable during shop drawing review phase of the project.
3. Shop Drawing submittal shall include:

   (a) General arrangement and installation drawings.

   (b) Wiring and schematic diagrams.

   (c) Specifications and data on the materials used, including NSF certifications. Specification of all equipment used on the skid.

   (d) Drawing defining terminal points of piping and wiring connections to items provided by the Contractor.

   (e) List of recommended spare parts.

1.4 WARRANTY

1. The manufacturer shall warrant the bare blower being supplied against all defects in workmanship and materials for a period of sixty (60) months from date of startup, not to exceed sixty-six (66) months from date of shipment from the manufacturer of the blowers. All other package components shall be warranted for a period of twelve (12) months from date of startup, not to exceed eighteen (18) months from the date of shipment.
2. The contractor shall be responsible for proper storage of the equipment so as to remain in "as shipped" condition. If the equipment remains in storage at the job

site for longer than six (6) months before installation, the contractor shall provide factory service personnel for a complete inspection of the equipment. Any work necessary to restore the equipment to “as shipped” condition shall be the responsibility of the contractor.

PART 2 -- PRODUCTS

2.1 Manufacturer

A. The equipment specified herein is intended to be standard equipment for use in low pressure air systems and be supplied by a single manufacturer or authorized sales representative to assure uniform quality, ease of maintenance, and minimal parts storage.

B. Manufacturer List:
   1. Kaeser Compressors, Inc.
      a. Model - Compak BB52C
   2. or Approved equal

C. Plan layouts, weights, and pertinent specification language used in the design have been based upon Kaeser Compressors, Inc. equipment. Any changes required to accommodate equipment other than the basis of design shall be provided by the Contractor at no additional expense to the Owner. Furthermore, a complete and detailed deviation list from the specification shall be provided with proposal.

2.2 Design Criteria

A. Standard Conditions for SCFM:
   1. Elevation: 14.7 PSIA (0’ elevation)
   2. Temperature: 68 deg F.
   3. Relative Humidity: 36%

B. Design (site) Conditions for ICFM:
   1. Elevation: 14.7 PSIA (30’ elevation)
   2. Maximum Blower Inlet Temperature: 68 deg F.
   3. Relative Humidity*: 80%

   *Relative humidity at maximum blower inlet temperature.

C. Performance Data:
   1. Application: air enhanced backwash of media filters for potable water
   2. Quantity: one
   3. Blower Packaged Controlled by a VFD: yes, internally controlled to maintain operator set discharge pressure
   4. Flow required: 98 SCFM
   5. Blower Package Discharge Pressure: 6 PSIG
   6. Motor Horsepower: 3 HP
      a. Motor shaft power shall account for belt losses in addition to internal package losses.
      b. The motor shall not operate in its service factor at design conditions.
      c. VFD efficiency loss shall be accounted for.
   7. Power supply voltage:
      a. Main motor: 460v / 3ph / 60hz
      b. Enclosure ventilation fan motor: 115v/ 1ph/ 60hz
   8. % of Maximum Blower Speed at 60hz: <= vendor stanadard

9. Blower Package Sound Level: 90 dB(A) at 3 feet*

* In accordance with ISO 2151, +/- 3 dB(A) at 1m, free field conditions, with insulated piping.

2.3 Blower Package Configuration:

A. Installation Location: inside heated building

B. Inlet Configuration: ambient (not piped, but can be piped if required by vendor)

C. All components and instrumentation are to be mounted and pre-piped; no field installation shall be required by the contractor. The manufacturer shall be responsible for all aspects of the engineering, from the blower package's air inlet to its discharge connection.

2.4 Bare Blower Construction

A. Blower type:
   1. The bare blower shall be mounted for vertical air flow, be of the oil-free, positive displacement, rotary three lobe type, designed for air or other inert gas service, and belt driven via electric motor.
   2. The bare blower assembly must operate at the effective value for vibration velocity in frequency range A and B, according to VDI 3836.

B. Material:
   1. AISI, ASTM, GJL, GLS, DIN, etc., numbers, types, and grades specified are typical of material composition and quality, equivalent materials will be considered.

C. Housing:
   1. The casing shall be made of high strength, close grained, cast iron, and shall be adequately ribbed to prevent casing deflection and facilitate cooling. Casing shall be of EN GG 20 material.
   2. The casing shall be precision machined to allow for minimum clearances.
   3. The casing shall include channels integrated on the discharge to reduce blower pulsation and dampen noise.
   4. The casing shall include threaded atmospheric vent ports between its air-side and oil-side labyrinth seals for safe separation of the conveying and oil chamber.
   5. Inlet and discharge ports shall be drilled and tapped for studs to allow solid connection of mating surfaces. Through bolting shall not be allowed. Flange style blower ports, which may be subject to loading, causing cylinder distortion, shall not be allowed.
   6. Bearing fits shall be precision machined to ensure accurate positioning of the rotors in the casing.

D. Rotors:
   1. The rotors shall be precision machined out of a one piece casting made of EN GGG 50 material. Stub shafts or two-piece impellers shall not be allowed.
   2. The rotor assemblies shall be statically and dynamically balanced to ISO standard 1940/1- Q2.5 (turbine rotor). Modifications to the face of the rotors for balancing purposes are not acceptable.
   3. The rotors shall be a tri-lobe design in order to minimize pulsation and noise.
   4. The rotor must be solid or closed-end to prevent build-up of contaminants inside the rotor causing imbalance.

5. Cored rotors must be closed using threaded iron plugs which are permanently fixed. Impeller end caps of stamped sheet metal shall not be allowed.
6. The rotors shall have an integral sealing strip for improved efficiency.
7. The rotors shall operate without rubbing, liquid seals or lubrication in the air chamber.

E. Cover Plates:
1. The gear-end and drive-end cover plates shall be high strength, close grained, cast iron made of EN GG 20 material. Aluminum cover plates shall not be allowed.
2. The cover plates shall have a precision machined sealing face.
3. The drive-end cover plate shall include at least two precision machined holes to allow for the use of fitting bolts to accurately align the opening for the input shaft seal.

F. Timing Gears:
1. The rotor timing gears shall be precision machined and ground from alloy steel made from case hardened 16 MnCr5 material.
2. Each timing gear shall be straight cut and beveled to quality standard 5f 21, which will eliminate axial bearing loads and ensure long life as well as quiet operation. Helical gears, which cause axial loading, shall not be allowed.
3. Each timing gear shall be manufactured in accordance with:
   a. DIN 3960, Specifications for Spur Gear Sets
   b. DIN 3961 & DIN 3962, Tolerances for Spur Gear Mesh
   c. DIN 3964, Specifications for Shaft Centering
4. The timing gear set shall be taper-mounted on the rotors. Keyed, hub mounted, taper-pinned, or splined shaft timing gear mounting designs are not acceptable.

G. Bearings:
1. All four rotor shaft support locations shall incorporate large, heavy-duty, full complement, cylindrical roller bearings with PEEK cages, designed with at least 5-times the dynamic capacity of ball bearings. Ball bearings shall not be allowed.
2. The bearing maximum speeds must be at least two times the maximum recommended blower speed.
3. The bearings minimum acceptable L10 design life shall be as follows;
   a. At least 40,000 hours at blower's maximum rated speed and maximum rated differential pressure.
   b. At least 100,000 hours at design conditions.

H. Lubrication:
1. Both the gear end and the drive end of the blowers shall be oil splash lubricated via a disc slinger for minimal maintenance and long service life. Grease lubricated bearings in the blower are not acceptable.
2. The lubrication design shall ensure adequate lubrication of the timing gears and bearings.
3. The drive-end and gear-end oil chambers must not be interconnected and each oil chamber shall have a domed design sight glass to allow visual inspection of oil level and oil condition, viewable from the front of the blower.
4. Blower to be factory filled with a synthetic lubricating fluid that is rated for the design conditions specified.

I. Rotor Seal Assembly:
1. Each rotor shall include one labyrinth seal assembly on each end, four assemblies in total per blower. Each seal assembly shall consist of the following;

a. Oil splash guard ring.
b. Shaft guide wear sleeve with vent holes located between the dual air and oil ring seals. Wear sleeve shall protect the blower casing.
c. Four piston ring type labyrinth seals made from heat treated GG/42CrMo4 material. Two seals located on the air side and two seals located on the oil side of the grooved rotor sleeve. The use of rubber lip seals shall not be allowed.
d. Grooved rotor sleeve which will protect the rotor shaft and be used to hold the four piston ring seals.

J. Input Shaft Seal Assembly:
1. The input drive shaft seal shall be a high temperature radial lip type seal made from Viton elastomer. The seal shall prevent oil leakage from where the input shaft goes thru the drive end cover.
2. The seal design shall incorporate a replaceable wear sleeve on the input drive shaft.
a. The sleeve exterior to be tungsten carbide coated to reduce friction and wear.
3. The input shaft seal design must allow for the lip seal and the shaft sleeve to be replaced without removing the drive end cover plate.

2.5 Motors:

A. Drive Motor:
1. Motor shall be designed, manufactured, and tested in accordance with the latest revised editions of NEMA MG-1, IEC, DIN, ISO, IEEE, ANSI, and AFBMMA standards as applicable and shall be capable of continuous operation.
2. Motor must meet or exceed Energy Independence and Security Act (EISA 2007) standards for NEMA Premium efficiency. It shall also be marked with a Department of Energy Certification Compliance Number to assure compliance.
3. Motor shall comply with Low Voltage Directive 2006/95/EC or equivalent and be UL listed.
4. Motor must be inverter rated with impulse peak resistance in accordance with IEC 60034-1:2010 or equivalent for operation with an IGBT frequency converter or equivalent.
5. Motor horsepower nameplate rating shall not be exceeded at the design discharge pressure when operating at 60hz.
6. The temperature rise of the motor windings shall not exceed IEC and NEMA standards when the motor is operated continuously at the rated horsepower, rated voltage, and frequency in ambient conditions at 104ºF / 40ºC.
7. Motor shall be suitable for Full Load/Direct On-line starting, Solid State Ramp starting, VFD, and/or Wye-Delta reduced current starting.
8. Motor to be supplied, mounted and aligned by the blower package manufacturer.
9. Motor shall confirm to the following:
a. Motor voltage: 460v/ 3ph/ 60hz
b. Type: Squirrel cage induction
c. Speed: Single
d. Torque: Constant
e. Service factor: 1.15
f. Enclosure: TEFC
g. Mounting: Horizontal
h. Speed: up to 3,600 rpm @ 60 hz (maximum)
i. Design: A
j. Duty cycle: continuous (24 hours a day)
k. Winding insulation: F
l. Temperature rise: B

m. Thermal motor protection: Positive Temperature Coefficient (PTC) thermistors (one per winding) wired in series. The use of thermostats is not allowed
    1) Connection of the PTC thermistors to the control system and signal processing is not part of the blower manufacturer's scope of supply.
n. Conduit box location: Top
o. Wiring Connection: Terminal strip inside conduit box. Use of wire nuts for connection of motor wiring to power source shall not be allowed.
p. Bearing L10 life: >40,000 hours
q. Bearing lubrication: Grease
r. Bearing type: Permanently greased
s. Bearing design: Cantilever forces (belt drive)
t. Condensation winding 110v heater: No

10. Motor shall be as manufactured by Siemens.
11. Connection and control of the drive motor to the control system is not part of the blower manufacturer's scope of supply

B. Sound enclosure ventilation fan motor:
1. Required with a 5 HP or larger main motor, or when the blower package is controlled by a VFD.
2. Motor voltage: reference Performance data – Power supply voltage
3. Motor shall be UL listed
4. Motor starter/ overload protection is the responsibility of the control system provider.
5. The fan motor should turn "on" when the main motor starts and turn "off" 10 minutes after the main motor stops. Controlling the fan motor via a thermostat shall not be allowed.
6. Connection and control of the fan motor to the control system is not part of the blower manufacturer's scope of supply.

2.6 Blower Package

A. Drive:
1. The blower shall be driven by the drive motor through a V-belt drive assembly designed to meet the blower conditions specified with a 1.2 or larger service factor.
    a. V-belts shall have a XPZ/XPB profile with embedded low-stretch polyester tension cords. The v-belts shall be designed for high rotational speeds and be heat and oil resistance. Ribbed, banded, or multi groove belts shall not be allowed.
    b. Sheaves shall have a SPZ/SPB profile and be balanced to G16 for below 30m/s and G6.3 for sheaves above 30m/s.
    c. Keyed taper bushing shall be used for easy installation and removal. QD type bushings shall not be allowed.
2. The blower drive must have a fully enclosed guard which protects the operator when the blower package enclosure is open while in operation.
    a. Belt guard shall be OSHA approved.
    b. The belt guard made from the manufacturer's standard sheet metal, shall be designed to duct the cooling air flow from the drive motor fan across the front of the blower to supplement blower input shaft seal cooling.
    c. The mounting fasteners for the belt guard shall be retained on the housing to prevent loss during maintenance.
3. Belt tension shall be accomplished by the use of a motor swing base and automatic tensioning assembly.
    a. The drive motor shall be mounted on a pivoting swing base with an axial adjustment for proper alignment of the v-belts. The weight of the drive motor shall

provide the primary belt tension. The use of a sliding motor mount shall not be allowed.

b. A tensioning assembly consisting of a threaded rod with spring shall be used to adjust the v-belt tension to prevent belt slippage and efficiently transmit power to the blower. It shall include a visual indication showing whether or not the v-belt tension is within the correct belt tension range.

c. Adjustment of the tensioning assembly shall be accomplished without removal of the guard or loosening of the motor mounting bolts.

d. The design of the swing base with tensioning assembly shall prevent the swing base from falling and creating a personnel hazard in the event of a belt failure. The tensioning assembly adjusting nut shall raise the motor swing base facilitating v-belt changes without the use of pry bars or jacks.

B. Inlet filter:

1. An inlet filter shall be provided to reduce the noise of the blower package.

a. The inlet filter assembly shall have a housing and clamp on lid of carbon steel construction and be directly connected to the inlet port of the blower.

b. The inlet silencer shall have an integral filter designed to protect the blower from particulates. It shall be located between the absorptive material and the blower inlet.

1) The filter element shall be a paper pleated element for minimal pressure drop.

2) The filter efficiency shall meet 99% SAE fine dust, particles larger than .0005mm separated to 100%.

3) The filter element integral to the filter shall be supplied no matter if the inlet configuration of the filter is ambient or piped. If required on a piped inlet configuration, any additional filtration or screening at the inlet location of the piped inlet air source is not the responsibility of the blower manufacturer.

4) Filter element shall be removable without disconnecting the inlet duct.

c. The filter maintenance cover and element must be removable by hand (without the use of tools).

d. The pressure loss thru the inlet filter assembly shall be accounted for in the motor horsepower selection of the blower package.

C. Base frame with integrated discharge silencer:

1. The blower base frame with integrated discharge silencer shall be designed for the frequency range of the blower, shall be provided to reduce the noise of the blower package as specified.

a. The blower base frame shall be of formed steel construction and designed for horizontal mounting of blower with vertical air flow. Flange-mounting only of the bare blower to the blower base frame shall not be allowed, additional support by use of the base frame shall be required; preventing the loading of the blower casing and discharge silencer shell.

b. The blower base shall incorporate the pivoting motor swing base and tensioning assembly to insure proper alignment of the drive assembly.

c. The discharge silencer shall be an integral part of the base frame.

d. The discharge silencer type shall be a combination of absorption, reflection and diffusion.

1) The design of the discharge silencer shall incorporate a solid outer and perforated inner cylinder with absorptive material in between the cylinders.

a) Absorptive material shall be long, flexible, knotted polyester fibers to allow for lowering the noise and heat emissions inside the sound enclosure. The use of mineral wool shall not be allowed.

2) The discharge silencer shall have connections ports for pressure relief, discharge pressure, and discharge temperature. Unused ports shall be capped or plugged.

e. The pressure loss thru the discharge silencer assembly shall be accounted for in the motor horsepower selection of the blower package.

D. Blower Sound Enclosure:

1. A sound enclosure shall be provided which fully covers the blower, motor, drive assembly, inlet silencer, blower base frame with integrated discharge silencer, and be shipped fully assembled.
   a. The sound enclosure shall be the product of the blower manufacturer to insure proper integration of blower package components.
   b. The sound enclosure shall meet the sound level specified.
   c. The sound enclosure acoustic material shall comply to FMVSS 302 with a burning rate B or lower than 100 mm/min.
   d. The sound enclosure assembly shall have a metal powder coated back with a lift off front panel made of rotomolded polymer polyethylene.
   e. The sound enclosure ventilation cooling air circuit shall be separate from the process air circuit. Mixing of the two air circuits within the enclosure shall not be allowed.
   f. The sound enclosure ventilation air exhaust and the ventilation fan shall be located towards the top of the sound enclosure.
      1) The ventilation fan shall be sized to provide adequate cooling of the blower package at all blower speeds.
      2) The ventilation fan voltage shall be as specified and run concurrent with the main motor. The ventilation fan shall not be controlled by a thermostat.
   i. The back of the sound enclosure shall have predrilled holes with grommets for easy pass-thru of electrical wiring.
   j. When installed outdoor, reference Blower Package Configuration Part 2.3. The instrumentation gauges shall be protected by a plexiglass cover and sound enclosure exhaust shall have a deflector hood.

E. Blower Package Accessories:

1. Pressure Relief Valve
   a. The relief valve(s) shall be factory installed within sound enclosure. Relief valve may not be shipped loose for field installation in the discharge piping.
   b. The relief valve(s) shall be spring type and must be sized for 100% of the design flow specified. Weighted relief valves shall not be used.
   c. The relief valve(s) shall be set to protect the blower from excessive differential pressure based on the design conditions specified.
   d. The relief valve(s) exhaust shall be vented out of the sound enclosure. Exhaust vented into the sound enclosure shall not be allowed.
   e. The relief valve shall be ASME, UV, CE, and PED certified.
2. Check Valve
   a. A check valve to prevent back flow through the blower shall be factory installed and not shipped loose for field installation in the discharge piping.
   b. The check valve flapper shall be swing type made from a steel disc embedded in a high temperature silicone elastomer. The valve shall be designed so that, in the event of failure, the valve element is retained in the valve housing.

c. The check valve capacity shall exceed the blower package's maximum discharge pressure and temperature.

3. Flexible Connector
   a. An elastomeric compensator/flex connector shall be provided to isolate the connection of the blower package to the self-supporting system piping. Restraining rods shall not be used. Flex connectors located between the bare blower and silencers shall not be allowed.
   b. The flexible connector capacity shall exceed the blower package's maximum discharge pressure and temperature.
   c. Discharge connection
      1) A web reinforced silicone rubber sleeve with corrosion resistant clamps shall be provided.
   d. Piped Inlet connection – When required, Reference Blower Package Configuration 2.3.
      1) A web reinforced silicone rubber sleeve with corrosion resistant clamps shall be provided.
4. Blower instrumentation gauges
   a. The following gauges shall be pre-piped and panel mounted on the front of the sound enclosure. Gauges shall not be shipped loose for field installation.
   b. Discharge pressure gauge
      1) The discharge pressure gauge shall measure the pressure at the discharge of the blower.
      2) The discharge pressure gauge shall be dual unit (English – PSI / Metric – Bar) with a range of 0 – 23 psi (0 – 1.6 bar). Minimum dial diameter shall be 2 ½", made with a stainless steel case and be glycerin filled for pulsation dampening.
   c. Discharge temperature gauge with adjustable switch
      1) The discharge temperature gauge shall measure the temperature at the discharge of the blower package.
      2) The discharge temperature gauge shall be dual unit (English - ºF / Metric - ºC) with a range from 32 – 392ºF (0 – 200ºC) and include an adjustable set point dial. Minimal dial diameter shall be 2 ½", made with a black plastic case and have a liquid filled measuring system that is converted by a Bourdon tube into a rotary movement of the pointer. The rotary movement of the pointer spindle shall operate a SPDT microswitch through a lever system. Voltage rating up 220v, 5amps.
      3) The high temperature set point shall be as recommended by the blower manufacturer.
      4) Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated.
   d. Filter differential pressure gauge
      1) The filter differential pressure gauge shall measure the pressure difference from ambient to the back side of the filter that is integral to the blower package's inlet silencer. When the filter starts to become dirty, the resistance shall be shown on a resettable red dial indicating when the filter shall be changed.
5. Oil Drains
   a. An oil drain from the blower drive-end and gear-end lubricating oil sumps shall be separately piped to the side of the blower base with flexible tubing. Common fill and drain shall not be allowed.

b. Each oil drain shall include a drain valve installed for ease of maintenance. The drain valves shall be 90° stainless steel ball valves and include a fully retained gasketed threaded cap to prevent accidental discharge of the blower lubricant.

6. Vibration isolators
   a. Vibration isolators shall be provided between the base frame with integrated discharge silencer and floor to prevent transmission of vibration to the foundation.

F. Optional Blower Package Accessories – the following options shall be supplied.
   1. Unloaded start valve
   a. The blower package when started with a “wye-delta” or “soft/reduced start” starter shall include a diaphragm operated, electro-mechanical unloaded start valve that is mounted between the blower and the discharge check valve.
   b. The unloaded start valve shall allow the blower drive motor to accelerate unloaded up to full speed before the discharge check valve opens.
   2. Inlet filter differential pressure switch
   a. The blower package shall include an installed filter differential pressure switch that shall measure the pressure differential across the integral inlet silencer’s filter.
   b. The filter differential pressure switch shall be field adjustable up to .73 PSI (50 mbar) and factory set at .5 PSI (35 mbar).
   c. The filter differential pressure switch shall be a SPDT switch, Voltage rating up to 250v, 10A
   d. Connection of the switch to the control system is not part of the blower manufacturer’s scope of supply. The switch shall be wired to shut down the blower package when actuated.
   3. Discharge pressure switch
   a. The blower package shall include an installed discharge pressure switch that shall measure discharge pressure of the blower.
   b. The discharge pressure switch shall be field adjustable.
   c. The discharge pressure switch shall be a SPDT switch, Voltage rating up to 250v, 1A
   d. Connection of the switch to the control system is not part of the blower manufacturer’s scope of supply. The switch shall be wired to shut down the blower package when actuated.
   4. Enclosure safety switch
   a. The blower package shall include an installed enclosure safety switch that shall thermostatically measure the temperature inside of the blower package’s enclosure.
   b. The enclosure safety switch shall be field adjustable and set at 140 deg F (60 deg C).
   c. The enclosure safety switch shall be a SPDT switch, Voltage rating up to 250v, 2.5 A
   d. Connection of the switch to the control system is not part of the blower manufacturer’s scope of supply. The switch shall be wired to shut down the blower package when actuated. It shall not be wired to turn on the enclosure vent fan.

G. Nameplates:
   1. The blower package shall have at least two weather proof corrosion resistant type nameplates which includes the manufacturer name, phone number, model number, year, capacity, max end pressure, max pressure difference, blower speed,

equipment number, part number, serial number, voltage, phase, HP, motor Hz/ rpm, and FLA attached on the outside and inside of the blower package.

H. Anchor bolts and hardware:
   1. Anchor bolts, washers, hex nuts, and all other fastening hardware shall be stainless steel and be supplied by the contractor.

I. Paint Specification:
   1. The blower manufacturer is responsible for surface preparation, priming and finish coating of the blower package and components requiring paint in accordance with the manufacture's standard procedures. Field painting of blower equipment or supplying components that are only prime painted is not acceptable.
      a. Cast parts are to be painted with a two part gray epoxy primer and two part top coat.
      b. Fabricated parts are to be painted with a two part gray epoxy primer and two part top coat.
      c. Sound enclosure metal parts are to be powder coated.
         1) Panels and base paint finish shall be pretreated by de-greasing and phosphate cleaning, then powder coated to a thickness of 70 µm -100 µm on both sides.
   2. The blower package to be painted the blower manufacturer's standard colors.

2.1 ELECTRICAL

A. Equipment and materials shall conform to Division 26, Electrical.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions and recommendations.

B. CONTRACTOR is responsible for all interconnecting piping, tubing, air lines, and electrical connections to ensure a complete installation matching the intent of the drawings and specifications.

3.2 START-UP, TESTING AND TRAINING

A. Manufacturer shall assign a start-up advisor and be available by phone for start-up and testing completed by the CONTRACTOR.

B. No on-site training is required for this item unless an alternate blower package has been provided by CONTRACTOR, in which case one day of on site training shall be provided by the manufacturers representative.

3.3 OPERATION AND MAINTENANCE MANUAL

A. The equipment manufacturer shall provide a complete operation and maintenance manual. Four (4) copies shall be provided to the Owner prior to start-up. The manual shall cover all components of the system, including information needed to order replacements parts, a list of recommended

spare parts, and data sheets for the operator to use for record keeping of operating data.

3.4 SPARE PARTS

A. Per manufacturers recommendation.

- END OF SECTION -