

B. SPECIFICATIONS

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DIVISION 01

GENERAL REQUIREMENTS

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SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work under Owner's separate contracts.
5. Owner-furnished/Contractor-installed (OFCI) products.
6. Contractor's use of site and premises.
7. Coordination with occupants.
8. Work restrictions.
9. Specification and Drawing conventions.

B. Related Requirements:

1. Section 01 50 00 - Temporary Facilities and Controls

1.2 PROJECT INFORMATION

A. Project Identification: Kenai WWTF Sludge Press Replacement – Phase 1

1. Project Location: Township 5N, Range 11W, Section 6, Seward Meridian.

B. Owner: City of Kenai, Public Works
210 Fidalgo Ave.
Kenai, AK 99611

1. Owner's Representative: Scott Curtin, Public Works Director, (907) 283-8236

C. Engineer: HDL Engineering Consultants, LLC
202 West Elmwood Ave.
Palmer, AK 99645

D. Engineer's Consultants: Engineer has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Wastewater Process Engineering: GV Jones and Associates, Inc.
2. Electrical and Mechanical Engineering: RSA, Inc.
3. Structural Engineering: Nelson Engineering, PC
4. Architectural: Umiaq Design, LLC
5. SCADA/Controls Design: TecPro Ltd.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and generally consists of the following:
1. Demolition: Remove two (2) existing digested sludge pumps, existing polymer system, existing roof-mounted air handler and associated ducting, select lighting, and two (2) existing doors. The Owner shall have first right of refusal on all salvageable materials. The Contractor shall dispose of, off site, all unwanted materials. Refer to the Asbestos Sampling Summary Report included as Item F. It will be the Contractor's responsibility to take this baseline data, and to conduct hazardous materials removal in compliance with all state and federal regulations. Develop and submit abatement plan to Engineer.
 2. Screw Press: Install one (1) owner furnished Andritz C-5427 screw press in parallel with the existing belt press. Refer to the Owner Furnished Equipment Information included as Item D.
 3. Ancillary Equipment: Furnish and install screw press equipment support, access platforms, process piping, two (2) digested sludge pumps, polymer system, washwater booster pump system, and one (1) screw conveyor.
 4. Ventilation Upgrades: Install exhaust fan, makeup air unit, and associated ducting.
 5. Structural Rehabilitation: Install one (1) door and rehabilitate interior rod bracing along two (2) walls.
 6. All other work indicated on the plans and in these specifications.
- B. Type of Contract:
1. Project will be constructed under a single prime contract.

1.4 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

1.5 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
 2. Provide for delivery of Owner-furnished products to Project site.
 3. Upon delivery, inspect, with Contractor present, delivered items.
 - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
 4. Obtain manufacturer's inspections, service, and warranties.
 5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
 2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
 3. Receive, unload, handle, store, protect, and install Owner-furnished products.
 4. Make building services connections for Owner-furnished products.
 5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
 6. Repair or replace Owner-furnished products damaged following receipt.
- C. Owner-Furnished/Contractor-Installed (OFCI) Products:
1. One (1) Andritz Screw Press Model C-5427. Refer to Section 46 71 46 – Screw Press (Owner Procured). Expected delivery to the project site is late-August/early-September, 2022.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Limits on 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. Limits on Use of Site: Confine construction operations to only those necessary for construction operations. Maintain access for WWTF operations at all time. Coordinate site access with Eric Jean, Kenai WWTF Operator, (907) 283-8266.
 2. Driveways, Walkways, and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1.8 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. Existing Utility Interruptions: 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:
 - 1. Notify Engineer and Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Engineer's written permission before proceeding with utility interruptions.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

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SECTION 01 14 00 – PROJECT CONSTRAINTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. CONTRACTOR shall furnish a Narrative Work Plan that describes the CONTRACTOR's phasing, and sequence of demolition and construction activities in the various areas at the Kenai Wastewater Treatment Facility (KWWTF). The Narrative Work Plan must identify those activities that may be performed concurrently and those that must be deferred or delayed until completion of other activities. The Narrative Work Plan must complement CONTRACTOR's schedule developed per Section 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION.
- B. The Narrative Work Plan must also discuss equipment CONTRACTOR will use to support prosecution of the work, addressing means and methods for removing the materials to be demolished. It must consider equipment dimensions and weights, proposed lifting methods, and mitigation of damage to yard piping and appurtenances, other building components, and equipment.
- C. A purpose of the Narrative Work Plan is to identify physical and scheduling constraints in the work beyond what is suggested or identified in these Technical Specifications and Drawings.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. Division 01 through Division 46.

1.3 PROJECT CONSTRAINTS

- A. The existing KWWTF is to be maintained in continuous operation during construction of the Project, except for limited shutdowns of portions of the unit processes as described herein. To this end, CONTRACTOR shall establish a schedule of proposed shutdowns in cooperation with OWNER and OWNER's plant operating staff, to minimize shutdown times through advanced planning. CONTRACTOR shall have all equipment, materials, and labor on hand at time of any planned shutdown. Work shall not proceed prior to the approval of associated submittals. Scheduled shutdown activity shall be included in the overall Project Schedule. The Project Schedule is to be updated and maintained as specified in Section 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION.
- B. CONTRACTOR shall minimize the need for and duration of shutdown(s) through advanced planning. Work shall not proceed prior to the approval of associated submittals specified in Section 01 31 00 PROJECT MANAGEMENT AND COORDINATION and Section 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION. For example, piping installation drawings shall be approved prior to the initiation of piping installation, etc. CONTRACTOR shall have all equipment, materials, and labor on hand at time of shutdown.

- C. The KWWTF will be occupied by OWNER throughout the construction period. CONTRACTOR shall provide all necessary access to OWNER's personnel as required to safely and efficiently operate/maintain the facilities. At all times during the Contract duration, CONTRACTOR is to provide OWNER's personnel and representatives safe and immediate access to all process control equipment. Additionally, CONTRACTOR is to provide for unimpeded access for all delivery vehicles transporting materials, chemicals, and/or equipment to the facility for OWNER's operations. This includes proper protection for temporary pipe systems.
- D. Bypassing of untreated or partially treated wastewater to the plant's effluent is not permitted.

1.4 SHUTDOWNS

- A. Plant operation shutdowns in this project may include:
 - 1. Power outages.
 - 2. Flow Interruptions.
 - 3. Unit process(es) removed from operation.
- B. A process shutdown may include a diversionary flow path for wastewater treatment process liquids, that will utilize pipes, pumps, tanks, controls, and/or other equipment (both permanent and/or temporary) to maintain an area suitable for entry, access, maintenance, repair, rehabilitation, installation, and/or inspection. The anticipated shutdowns affect single treatment unit processes, and do not affect the overall treatment capability of the KWWTF, with the exception of a plant wide power outage, where tight controls are implemented to minimize number and duration of power outages.
- C. Shutdowns shall be accomplished by CONTRACTOR in cooperation with OWNER's Plant Superintendent only when properly coordinated in advance by CONTRACTOR and OWNER in accordance with the requirements of this section and Section 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION.
- D. CONTRACTOR shall submit a detailed shutdown plan and time schedule for flow interruptions, unit process(es) removed from operation, and power outages, at least three (3) weeks prior to the scheduled shutdown or power outage.
- E. CONTRACTOR shall provide all temporary power circuits to minimize power outages.
- F. CONTRACTOR shall provide all temporary communication circuits to minimize plant shutdowns.
- G. Unless otherwise coordinated with and approved by OWNER/Plant Superintendent, the following shall apply:
 - 1. Shutdowns and power outages shall be initiated and completed only during normal working hours of KWWTF operating personnel, or as otherwise coordinated with and approved by OWNER.
 - 2. Shutdown(s) requiring flow interruption(s) will need to occur during the time of day, and day of the week when the plant receives its lowest wastewater flow.

3. Shutdowns and power outages shall be coordinated with and approved by OWNER/Plant Superintendent at least 48 hours prior to the scheduled interruption.
 4. Power outages shall not exceed 30 minutes, and not more than one in a day.
- H. Redundant equipment shall be available onsite for deployment during any flow diversion that has potential to overflow the treatment process or backup the collection system in the event of an equipment failure. CONTRACTOR shall have monitoring equipment in place and personnel scheduled to respond in a reasonable amount of time to a situation that could result in overflow. This is to be coordinated with OWNER as part of the Narrative Work Plan.
- I. Anticipated Shutdowns
1. Shutdown/Unit Process Removed from Operation:
 - a. Existing belt press operations will be taken offline to enable Digested Sludge piping and W2 piping modifications.
 - b. Existing polymer solution preparation and poly solution dosing pumping will be taken offline to enable replacement poly prep and poly dosing equipment to be installed.
 - c. Electrical power interruptions to MCC1 will be needed to accommodate safe modifications of that equipment as needed to supply power to the new process equipment.

1.5 SEQUENCE OF CONSTRUCTION

- A. General:
1. The initiation of demolition Work will only be allowed after CONTRACTOR's submission and OWNER's review and approval of the detailed construction schedule and the CONTRACTOR's Narrative Work Plan.
 2. The intent of the sequence of construction is the orderly progression of the Work with a minimization of temporary facilities, the completion of activities in a logical fashion that eliminates rework, coordination of all new installations to complete the overall project within the time frame outlined in the contract documents.
 3. CONTRACTOR shall coordinate with OWNER for needed plant lockout and returning plant to service. OWNER will lead in these activities with CONTRACTOR's participation and assistance.
 4. OWNER must continue to operate the KWWTF except for limited shutdowns. As such, this sequence of construction tries to provide a scenario where interruptions to plant operations are minimized, by providing temporary work-arounds as needed, and completing major portions of construction prior to making relatively quick cut-ins when temporarily interrupting process flows.
 5. While there are operational and contractual constraints to the progression of the Work, the sequence of activities outlined herein is not mandatory as presented and shall not be

interpreted to preclude CONTRACTOR's alternative approaches to sequencing the Work. CONTRACTOR will prepare and submit CONTRACTOR's recommended sequence of construction that optimizes efficiency for CONTRACTOR while limiting operational impacts to OWNER.

- B. A candidate Sequence of Construction for major Work items follows. The Contractor may elect to alter and execute revisions to this sequence, pending approval of the Narrative Work Plan that addresses his preferred work plan sequence:

1. Heating and ventilation system work scope
 - a. The heating and ventilation improvements should be sequenced ahead of process equipment improvements so that compliance with NFPA 820 can be maintained at all times during the construction activities.
 - b. Demo
 - 1) ASU-3 and associated ductwork and controls
 - 2) Patch R/A opening through the roof
 - c. New heating and ventilation infrastructure
 - 1) New MAU-1 install
 - 2) New EF-1 install
 - 3) New S/A and E/A ductwork
 - 4) New natural gas supply piping renovations
 - d. Air balancing and confirmation of heat and vent equipment performance
2. Structural and architectural work scope
 - a. Demo
 - 1) Mandoors
 - b. Renovations
 - 1) Repair and renovate pre-engineered metal building (PEMB) structural members
 - 2) Infill demolished mandoors
 - c. Remodel and upgrades
 - 1) New mandoors and associated framing
 - 2) New architectural accent panel
 - 3) Paint systems for structural members
 - d. Concrete
 - 1) Structural pad for jib crane
 - 2) Concrete curbing for spill containment

- e. Screw Press Equipment access platform
- 3. Process equipment work scope
 - a. Polymer System Renovations
 - 1) Set up temporary polymer preparation by relocating one of the existing mix tanks and dosing pumps for belt press operations. Provide temp hot water service for poly solution prep in this temporary system.
 - 2) Demo remaining existing polymer mix tank and dosing pump.
 - 3) Remodel cold and hot non-potable water supply piping systems
 - 4) Remodel raised floor grating system in polymer preparation area
 - 5) Install new polymer process equipment
 - a) Neat polymer storage tank with tank mixer assembly
 - b) Polymer makeup unit
 - b. Set jib crane
 - c. Set screw press and flocculation tank
 - d. Set new air compressor
 - e. Set new sludge screw conveyor
 - f. Set non-potable water booster pump skid
 - g. Set process Equipment Control Panels
 - 1) Screw press
 - 2) Screw conveyor
 - 3) W2 Booster pumps
 - 4) Polymer makeup equipment
 - 5) Digested sludge pumps
- 4. Process piping renovations
 - a. Polymer piping
 - b. Digested sludge piping including polymer mix ring
 - c. Non-potable W2 and hot water piping
- 5. Electrical power and lighting system renovations
 - a. New exit lighting
 - b. New power distribution panel in MCC1
 - c. New conduit and conductor distribution for project

6. Instrumentation and control system renovations
 - a. New process instrumentation
 - 1) Pumped digested sludge pressure indicator/transmitters
 - 2) Digested sludge flow indicator and transmitter mag meter
 - 3) Polymer flow indicator and transmitter mag meter
 - b. VFD configurations
 - c. Software loading onto PLC equipment
7. Functional testing
 - a. Process piping pressure testing
 - b. Power phase and rotation checks for three phase motors
 - c. Comm checks for connected communications cabling
 - d. Functional verification of automated control
8. Project commissioning
 - a. Startup and performance monitoring of process equipment
 - 1) Polymer makeup equipment
 - 2) W2 pumps
 - 3) Digested sludge pumps

1.6 REQUIREMENTS FOR SUBSTANTIAL COMPLETION

- A. Substantially Complete means the following is fulfilled:
 1. Successful completion of work scope described in Section 01 75 00 STARTING AND ADJUSTING for all systems and equipment.
 2. Demonstrating sustained operations of the screw press mechanical sludge dewatering process.
 3. Submittals have been completed and approved.
 4. Spare parts and expendable supplies and test equipment have been delivered to OWNER.
 5. Punch-list items have been corrected.
 6. Red-lines/record drawings in both hard-copy and electronic format have been submitted and approved.
 7. Revisions to the Technical Manuals that may have resulted from the field tests have been made and reviewed and approved.

8. Operator training for new equipment has been completed.
9. Operator training has been completed using approved O&M manuals.
10. Construction debris has been removed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide area lighting to support construction and on-going treatment operations.
- B. Control fugitive dust to prevent dust entry into existing ventilated electrical panels and enclosures.
- C. No physical Work will be allowed to commence at the project site prior to approval of CONTRACTOR's schedule and Narrative Work Plan.

END OF SECTION 01 14 00

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SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 01 60 00 - Product Requirements

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form acceptable to Engineer.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific

- features and requirements indicated. Indicate deviations, if any, from the Work specified.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Cost information, including a proposal of change, if any, in the Contract Sum.
 - j. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - k. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within fifteen days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Engineer's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than fifteen days prior to time required for preparation and review of related submittals.
1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Engineer will consider requests for substitution if received within sixty days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Engineer.
1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.

- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Engineer will issue a Field Order authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.
 - 1. Work Change Proposal Requests issued by the Engineer are not instructions either to stop work in progress or to execute the proposed change.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 7 days, unless otherwise stated, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Use AIA Document G709 or similar form, approved by Owner and Engineer, for Proposal Requests.

1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor.

1.5 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Engineer may issue a Work Change Directive which instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: For time and material basis work, maintain detailed records on a time and material basis of work required by the Work Change Directive. Daily time records are to be submitted to the Engineer by 9:00 am on the following workday.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

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SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Application for Payment forms, Submittals Schedule and Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to Engineer at earliest possible date but no later than 20 days after effective date of notice to proceed and prior to commencement of work.
- A. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each applicable Specification Section.
 - 1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Engineer.
 - c. Engineer's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Submit draft Schedule of Values for approval.
 - 3. Provide a breakdown of the Contract Sum items in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items for operation and maintenance manuals, Project Record Documents, and demonstration and training in the amount of 5% of the Contract Sum.
 - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 - 5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. 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.
 - a. 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.
8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.
- B. Payment Application Times: Submit Application for Payment to Engineer by the fifth of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
- C. Payment Application Forms: Use form EJCDC No. C-620 and additional supporting forms as provided by Owner or other mutually agreeable form.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit one (1) signed copy of each Application for Payment to Engineer. Execute by a person authorized to sign legal documents on behalf of Contractor. Include waivers of lien and similar attachments as required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
 2. Attach copies of Certified Payroll Reports submitted to the Alaska DOL during the period covered by the Application.

- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Submittal schedule (preliminary if not final).
 - 5. List of Contractor's staff assignments.
 - 6. Initial progress report.
 - 7. Report of preconstruction conference.
 - 8. Certificates of insurance and insurance policies.
 - 9. Notice of Work submitted to Alaska DOL.
- H. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Contract Completion and Acceptance Certificate
 - 3. Contractor's Statement Concerning Claims
 - 4. AIA Document G707, "Consent of Surety to Final Payment."
 - 5. Evidence that claims have been settled.
 - 6. Final, liquidated damages settlement statement.
 - 7. Notice of Completion of Public Works submitted to Alaska DOL.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. RFIs.
 - 2. Project meetings.
- B. Related Requirements:
 - 1. Section 01 73 00 - Execution

1.2 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

1.4 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Contractor.
 - 4. Name of Engineer
 - 5. RFI number, numbered sequentially.
 - 6. Specification Section number and title and related paragraphs, as appropriate.
 - 7. Drawing number and detail references, as appropriate.
 - 8. Field dimensions and conditions, as appropriate.
 - 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 10. Contractor's signature.
 - 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation. Each page of attachments shall be identified with the RFI number and sequential page number.
- C. RFI Forms: Mutually acceptable form with the same content as indicated above, acceptable to Engineer.
- D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
 - 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Engineer's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.
 3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within seven days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use mutually acceptable form, including the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Engineer.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Engineer's response was received.
 8. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.5 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Engineer will record significant discussions and agreements achieved and distribute the meeting minutes to everyone concerned, including Owner and Contractor, within three days of the meeting.
- B. Preconstruction Conference: Engineer will schedule a preconstruction conference before Contractor starts construction, at a time convenient to Owner, Engineer and Contractor, but no later than 15 days after execution of the Agreement. The Engineer will conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of Record Documents.
 - l. Use of the premises.
 - m. Work restrictions.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Construction waste management and recycling.
 - q. Office, work, and storage areas.
 - r. Equipment deliveries and priorities.
 - s. First aid.
 - t. Security.
 - u. Progress cleaning.
 - v. Working hours.
 3. Minutes: Engineer will record and distribute meeting minutes.
- C. Progress Meetings: Owner or Owner's representative will conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) RFIs.
 - 16) Status of proposal requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
3. Minutes: Engineer will record the meeting minutes.
4. Reporting: Engineer will distribute minutes of the meeting to each party present and to parties who should have been present.
 - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule within one working day of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Construction schedule updating reports.
 - 3. Daily construction reports.
 - 4. Site condition reports.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

1.3 SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Construction Plan: Submit a detailed plan for constructing the proposed improvements for Engineer's review. Construction plan shall indicate sequence of shut-down of critical facilities and Contractor's plan to accommodate the need of the WWTF to process digested sludge. Provide sufficient detail to clearly indicate the proposed work sequence, schedules, and disruption of service to accommodate installation of proposed facilities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at bi-weekly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Engineer.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 30 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 3. Work Restrictions: Show the effect of the following items on the schedule:

- a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion and the following interim milestones:
- 1. Screw press startup, commissioning, testing, and training.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
- 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At bi-weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
- 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate final completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours,

working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

- I. Distribution: Distribute copies of approved schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.6 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.

- c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and final completion.
 - l. Activities occurring following final completion.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.

6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

1.7 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Stoppages, delays, shortages, and losses.

11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Work Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Engineer.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.

7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.
 16. Signature of transmitter.
- B. Options: Identify options requiring selection by Engineer.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
1. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Retain "Electronic Submittals" Paragraph below if requiring electronic submittals to be sent to Architect via email.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number. PDF documents shall be text-searchable.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package, and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.6 CONTRACTOR'S USE OF ENGINEER'S CAD FILES

- A. General: At Contractor's written request, one copy of Engineer's CAD files will be provided to Contractor for Contractor's use in Project layout and staking, subject to the following conditions:
1. Files will be prepared in AutoCAD 2019 and will include base mapping and plan view design linework only.
 2. Engineer makes no representation as to accuracy or integrity of data

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:

- a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
- 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Engineer will retain two Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

- 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.

2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ENGINEER'S REVIEW

- A. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required and return it.
 1. PDF Submittals: Engineer will indicate, via markup on each submittal, the appropriate action.
- B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Engineer will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Engineer without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 33 00

SECTION 01 35 16 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Engineer's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. 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.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Engineer.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep existing items that are not to be removed or dismantled.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Conference for Alteration Work: Before starting alteration work, Contractor will conduct conference at Project site.
 - 1. Attendees: In addition to representatives of Owner, Engineer, and Contractor, testing service representative, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
 - 2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
 - a. Fire-prevention plan.
 - b. Governing regulations.
 - c. Areas where existing construction is to remain and the required protection.
 - d. Hauling routes.
 - e. Sequence of alteration work operations.
 - f. Storage, protection, and accounting for salvaged and specially fabricated items.
 - g. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
 - 3. Reporting: Contractor will record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

1.4 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

1.5 INFORMATIONAL SUBMITTALS

- A. Alteration Work Program: Submit 30 days before work begins.
- B. Fire-Prevention Plan: Submit 30 days before work begins.

1.6 QUALITY ASSURANCE

- A. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.
- B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.

1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- D. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

1.7 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
1. Repair and clean items for reuse as indicated.
 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label 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 unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Engineer, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
 2. Secure stored materials to protect from theft.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
 - 1. Use only proven protection methods, appropriate to each area and surface being protected.
 - 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 - 3. Erect temporary barriers to form and maintain fire-egress routes.
 - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
 - 5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
 - 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 - 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 - 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
 - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
 - 1. Notify Owner, Engineer, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 - 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Engineer immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.

1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

F. Existing Roofing: Prior to the start of work in an area, install roofing protection.

3.2 PROTECTION FROM FIRE

A. General: Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated.
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.

- e. Maintain fire-watch personnel at Project site until 60 minutes after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
 - 1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- B. Notify Engineer of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Engineer.

END OF SECTION 01 35 16

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See Divisions 2 through 46 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.
- C. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- D. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- E. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- F. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

- G. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- H. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Engineer for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.4 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Reports: Prepare and submit certified written reports that include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.

8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.
- F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

- G. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.6 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

- E. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.7 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 QUALITY CONTROL TESTING REQUIREMENTS

- A. See Division 2 through 46 Sections for testing frequency requirements for these sections.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the General Conditions of the Contract and the Agreement Between Owner and Contractor.
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.

ADAAG	Americans with Disabilities Act (ADA)
CFR	Code of Federal Regulations
CRD	Handbook for Concrete and Cement
DOD	Department of Defense Military Specifications and Standards
FED-STD	Federal Standard (See FS)
FS	Federal Specification
IBC	International Building Code, latest edition
SSHC	Standard Specifications for Highway Construction by ADOT&PF

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

ACI	ACI International (American Concrete Institute)
ADOT&PF	Alaska Department of Transportation and Public Facilities
AGC	Associated General Contractors of America (The)
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APA	Architectural Precast Association

ASCE	American Society of Civil Engineers
ASME	ASME International (The American Society of Mechanical Engineers International)
ASTM	ASTM International (American Society for Testing and Materials International)
AWS	American Welding Society
AWWA	American Water Works Association
CSI	Construction Specifications Institute (The)
EJCDC	Engineers Joint Contract Documents Committee
FM	Factory Mutual System (See FMG)
FMG	FM Global (Formerly: FM - Factory Mutual System)
NACE	NACE International (National Association of Corrosion Engineers International)
NFPA	NFPA (National Fire Protection Association)
NSF	NSF International (National Sanitation Foundation International)
UL	Underwriters Laboratories Inc.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

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SECTION 01 43 33 - MANUFACTURERS' FIELD SERVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Manufacturers' services for Contractor furnished/installed equipment to include:
 - 1. Review and inspect Manufacturer's equipment as installed by CONTRACTOR at OWNER's treatment plant and subsequent reporting on the proper installation and operation of the equipment.
 - 2. Execution of Facility Startup Services per Section 01 75 00 STARTING AND ADJUSTING.
 - 3. Completion of administrative and procedural requirements for instructing OWNER's personnel in the use of Manufacturers' equipment, including the following:
 - a. Demonstration of operation of systems, subsystems, and equipment
 - b. Training of OWNER's operations personnel in operation and maintenance of systems, subsystems, and equipment furnished and installed in this Contract.
- B. Contractor services for Owner furnished/Contractor installed equipment to include:
 - 1. Furnish polymer product for screw press dewatering startup and performance testing.
 - 2. Provide support to Owner furnished equipment Manufacturer during their efforts at the Project site as follows
 - a. Coordinate on scheduling and provide access to enable inspection of the installation of their equipment at the Project site
 - b. Coordinate on completion of corrective action recommended by Owner furnished equipment Manufacturer for installation of Owner furnished equipment
 - c. Provide construction trade labor and tool resources to the Owner furnished equipment Manufacturer during functional testing and performance evaluation of Owner furnished equipment.
 - 3. Provide laboratory testing services for screw press dewatering startup and performance evaluations.

1.2 WORK NOT INCLUDED

- A. Contractor not responsible for the following Owner furnished equipment Manufacturers' services:

1. Project site inspection and follow on reporting on status and adequacy of installed screw press equipment by Owner furnished equipment Manufacturer
2. Functional checkout of installed screw press equipment by Owner furnished equipment Manufacturer
3. Commissioning installed screw press equipment by Owner furnished equipment Manufacturer
4. Training Owner's personnel on operation of screw press equipment by Owner furnished equipment Manufacturer

1.3 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. 01 10 00 – Summary
- C. 01 33 00 – Submittal Procedures
- D. 01 60 00 – Product Requirements
- E. 01 75 00 – Starting and Adjusting
- F. 01 79 00 Demonstration and Training
- G. DIVISION 26 – Electrical
- H. DIVISION 40 – Process Interconnections
- I. 41 12 13.36 – Screw Conveyor
- J. 43 23 00 – Process Pumps
- K. 46 33 33 – Polymer Blending and Feed Equipment

1.4 DEFINITIONS

- A. Manufacturer (Equipment Supplier): The entity which fabricates and furnishes CONTRACTOR the equipment specified for inclusion in the Work.
- B. Manufacturer's Representative: The person with requisite qualifications designated, trained, and directed by the Manufacturer (Equipment Supplier) to perform Manufacturers' Services as required by these Contract Documents.
- C. Owner furnished equipment Manufacturer: Andritz, or their trained representative providing services to the Project.

1.5 SUBMITTALS

- A. Prepare, deliver, and process submittals under provisions of Section 01 33 00 SUBMITTAL PROCEDURES.
- B. Complete list of all deviations from the Drawings and Specifications.
- C. Administrative and quality control documentation:
 - 1. Certificates of Proper Installation for Contractor furnished and Installed Equipment
 - 2. Schedules for Facility Startup per Section 01 75 00 STARTING AND ADJUSTING.
 - 3. Supporting Documentation for Operator Training Services for Contractor furnished and installed equipment.
- D. Certificates of Proper Installation and Operation for Contractor furnished and Installed Equipment
 - 1. Provide OWNER
 - a. Report of Observations made during onsite inspections
 - b. Certification of Proper Installation and Operation
 - c. Use Certification Form attached to this Section
- E. Operator Training. The submittals requested below will be used by OWNER in coordination with the State to authorize the training opportunity as continuing education for the operators in attendance.
 - 1. Instructor. Submit information on background, training, education, and experience of Manufacturer's Representative providing the training.
 - 2. Training Schedule:
 - a. Submit not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.
 - b. Coordinate with Owner to schedule training to occur when operations personnel are available.
 - c. List specified equipment and systems that require training services and show:
 - 1) Respective manufacturer.
 - 2) Estimated training dates.
 - 3) Allow for multiple on-site training sessions when several shifts of OWNER operations staff are involved.
 - 3. Instruction Program: Not less than 14-days prior to scheduled training, submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

4. Training Session DVD(s): Furnish OWNER with two complete sets of DVDs fully indexed and cataloged with printed label stating session and date taped.

1.6 QUALITY ASSURANCE

- A. Qualifications of Manufacturer's Representative: An individual representative of the Manufacturer, factory trained and experienced in the technical applications, installation, operation, and maintenance of the equipment furnished to CONTRACTOR for use in the Work.
- B. Qualifications of Training Instructor:
 1. Individual with qualifications same as Manufacturer's Representative, and
 2. Individual with experience in training or educating operations and maintenance personnel using programs similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- C. Combined Manufacturer's Representative and Training Instructor
 1. The same individual may serve as both the Manufacturer's Representative and the Training Instructor if the following submittals are made to, and accepted by OWNER:
 - a. Resume of individual indicating his factory training and experience with fabrication, operation, maintenance, and troubleshooting the type of Manufacturer's Equipment furnished to the Work
 - b. Documentation indicating other locations and/or personnel with contact information for same, where Manufacturer's Representative has provided training services for operations personnel in the use of Manufacturer's Equipment
- D. Training Support Documentation
 1. Coordinate content of training modules with content of approved operation, and maintenance manuals.
 2. Do not submit instruction program until Operation and Maintenance manual submittals have been received, reviewed, and approved by OWNER.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specifications.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.
2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.
3. Emergencies: Include instructions on stopping; shutdown; operating outside normal operating limits; emergency and failure operations, and meaning of error messages, warnings, and trouble indications.
4. Operations: Include startup, process control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems and controls.
5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.
6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.
7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.
8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.
9. Additional requirements may be included in individual specification sections and Drawings.

PART 3 - EXECUTION

3.1 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION AND OPERATION

- A. When so specified, a Manufacturer's Certificate of Proper Installation and Operation form, a copy of which is attached to this section, shall be completed and signed by the equipment manufacturer's representative.
- B. Travel to OWNER's Kenai Treatment Plant is required for observation and evaluation of installed equipment.
 1. The total number of site visits, and duration of time on site for each is specified in individual equipment Specification Sections of these Contract Documents.
 2. Depending on individual Specification requirements and sequence of construction, multiple separate inspections may be required, to complete the Manufacturer's Certification of Proper Installation and Operation. One inspection may address review of installed equipment for proper installation, and a second for observation of proper

operation following completion of Facility Startup. See individual Specification Sections for details of requirements.

C. Scheduling

1. Provide Schedule of Inspection to OWNER at least fourteen (14) calendar days in advance of inspection.
2. Revise schedule as needed to meet availability of OWNER's staff.
3. Schedule inspection to occur only during Normal Work days and hours of the Kenai treatment plant operating personnel, or as otherwise coordinated with and approved by OWNER.

3.2 MANUFACTURER'S CERTIFICATE OF TRAINING

- A. When so specified, a Manufacturer's Certificate of Training form, a copy of which is attached to this section, shall be completed and signed by the equipment Manufacturer's representative.
- B. Travel to OWNER's treatment plant is required for Qualified Training Instructors as defined by these Specifications to instruct OWNER's personnel to adjust, operate, and maintain systems, subsystems, and equipment furnished by the Manufacturer. On request, OWNER will furnish historic operational philosophy for systems within the existing treatment plant.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with OWNER at least fourteen (14) calendar days in advance.
 2. Training shall not be done during Facility Startup or Functional Check Out activities. It is to be done subsequent to these activities.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, a written, and a demonstration performance-based test.

3.3 DEMONSTRATION AND TRAINING VIDEO

- A. General: Engage qualified personnel or service provider to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video Format: Provide high-quality AVI or WMV video file format on DVD video disc or USB drive.
- C. Narration: Describe scenes on video by audio narration by microphone while video is recorded. Include description of items being viewed.

3.4 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Where time is necessary more than that stated in the Specifications for Manufacturers' Services, or when a minimum time is not specified, the time required to perform the specified services shall be considered incidental. Only those days of service approved by OWNER will be credited to fulfill the specified minimum services.
- B. Schedule Manufacturers' Services to avoid conflict with other onsite testing or other manufacturers' onsite services.
- C. Determine, before scheduling services, that all conditions necessary to allow successful testing have been met.

3.5 FORMS

- A. Attached forms are part of this specification.

END OF SECTION 01 43 33

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MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION AND OPERATION

Owner _____ SERIAL NO: _____
TAG NO: _____ EQUIPMENT: _____
PROJECT NO: _____ SPECIFICATION SECTION: _____
Area / Equipment of Demonstration: _____

I hereby certify that the above-referenced equipment/system has been (Check Applicable):

- ☐ Installed in accordance with Manufacturers' recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ A functional check out of the system has been performed; the system performance tested, and meets or exceeds specified operation and performance requirements. (When complete system of one manufacturer)

Startup Sequence (Describe sequence for startup, if any):: _____

Comments: _____

I, the undersigned Manufacturer's Representative, hereby certify that I am a duly authorized representative of the manufacturer and can inspect, approve, and operate this equipment and am authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational. I further certify that all information contained herein is true and accurate.

Date: _____, 20____ Manufacturer: _____

By Manufacturer's Authorized Representative: _____

Contractor Certification that equipment is capable of performing its intended function(s), including fully automatic operation, if applicable:

Date: _____, 20____ Contractor: _____

Date: _____, 20____ Owner: _____

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MANUFACTURER'S CERTIFICATE OF TRAINING

Owner _____ SERIAL NO: _____
TAG NO: _____ EQUIPMENT: _____
PROJECT NO: _____ SPECIFICATION SECTION: _____
I hereby certify that the above-referenced equipment/system has been (Check Applicable):

☐ Presented to the attached list of attendees in an Owner approved training program.

Name (Please print legibly)

Name (Please print legibly)

I, the undersigned Manufacturer's Representative, hereby certify that I am a duly authorized representative of the manufacturer and am authorized to provide training and instruction for the aforementioned equipment and systems. I further certify that all information contained herein is true and accurate.

Date: _____, 20____

Manufacturer: _____

By Manufacturer's Authorized Representative: _____

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SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 DEFINITIONS

- A. Permanent Enclosure: As determined by Engineer, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.3 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Engineer, testing agencies, and authorities having jurisdiction.

1.4 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70 and utility company, as applicable.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Provide sanitation facilities at the project site and a source for drinking water. Mobilization, demobilization, and usage fees shall be subsidiary to the Contract.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work and the operation of the existing facility. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 1 Section "Execution" for progress cleaning requirements.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

- B. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- C. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended or no later than Final Inspection. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor.

END OF SECTION 01 50 00

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SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 25 00 - Substitution Procedures
 - 2. Section 01 33 00 – Submittal Procedures

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design

product also establish salient characteristics of products for purposes of evaluating comparable products.

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 "Submittal Procedures."
- F. Substitution: Refer to Section 01 25 00 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

1.5 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

- a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 25 00 "Substitution Procedures" for substitutions for convenience.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Engineer's Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 01 33 00 "Submittal Procedures."
1. Form of Approval of Submittal: As specified in Section 01 33 00 "Submittal Procedures."
 2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Single-Step Process: When acceptable to Engineer, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Engineer of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

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SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Installation of the Work.
 - 2. Coordination of Owner's portion of the Work.
 - 3. Coordination of Owner-installed products.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for coordination of Owner-furnished products, and limits on use of Project site.
 - 2. Section 01 40 00 - Quality Requirements
 - 3. Section 01 75 00 – Starting and Adjusting
 - 4. Section 01 77 00 - Closeout Procedures

1.2 QUALITY ASSURANCE

- A. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 1. Before construction, verify the location and invert elevation at points of connection of process piping, water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where

indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

3.3 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb, and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 01 77 00 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.4 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.
 - 1. Provide temporary facilities required for Owner-furnished, Contractor-installed products.
 - 2. Refer to Section 01 10 00 "Summary" for other requirements for Owner-furnished, Contractor-installed products.

- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

3.5 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 75 00 "Starting and Adjusting."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.7 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 75 00 – STARTING AND ADJUSTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The CONTRACTOR shall perform wastewater treatment equipment and systems Starting and Adjusting as described herein.
- B. Equipment and systems startup and testing shall be done in accordance with the requirements of the applicable specification Divisions.
- C. Where provisions of this section conflict with specific testing requirements found elsewhere in these Documents, such specific testing requirements shall govern. The provisions of this section shall apply to all equipment and systems, and specific testing requirements found elsewhere in these Documents shall be considered complementary, and testing requirements in both sections shall apply.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. 01 10 00 – Summary
- C. 01 33 00 – Submittal Procedures
- D. DIVISION 26 – Electrical
- E. DIVISION 40 – Process Interconnections
- F. 40 05 01 – Process Piping
- G. 40 05 50 – Process Valves and Operators
- H. 40 71 10 – Flow Measuring Devices
- I. 40 90 00 – Process Instrumentation and Controls
- J. 40 91 19.29 – Pressure Measuring Systems
- K. 41 12 13.36 – Screw Conveyor
- L. 43 23 00 – Process Pumps
- M. 46 33 33 – Polymer Blending and Feed Equipment

1.3 DEFINITIONS

- A. Facility Startup: Facility Startup is the process of putting the Project in operating order. A phased sequence of construction, further described in specification Section 01 14 00 PROJECT CONSTRAINTS, is to be completed.
- B. Items of Work to be completed prior to Facility Startup include but are not limited to: demolition of existing infrastructure, procurement and installation of the new system infrastructure, cleaning, flushing, and pressure testing of piping systems and process equipment.
- C. Facility Startup is to include the following items:
 - 1. Verification by equipment Manufacturer(s) that their equipment is properly installed and ready for startup.
 - 2. Confirmation that all electrical power and control communications connections are correctly terminated.
 - 3. Confirmation of complete and functional electrical and control systems, including instrumentation, control devices, and rotating equipment operation upon being energized.
 - 4. Functional Testing of equipment and systems.
 - 5. Performance Testing to verify performance requirements specified.
 - 6. Operation of the system over the period specified for Facility Startup to verify system operation and performance.
 - 7. Supporting the OWNER in control system commissioning operation and performance devices and equipment for all specified control sequences.
- D. Functional Test: A test or tests in the presence of the OWNER to demonstrate that the installed equipment and systems meet functional performance requirements including, but not limited to: noise, vibration, alignment, speed, proper electrical and mechanical connections, thrust restraint, proper rotation, and initial servicing.
- E. Performance Test: A test or tests in the presence of the OWNER after any required Functional Test specified, to demonstrate and confirm that the installed equipment and systems meet the specified performance requirements including, but not limited to:
 - 1. Pumping systems including non-potable water booster pump skid, digester sludge pumps, polymer dosing pumps: flow and head, power draw.
 - 2. Dewatering equipment: Owner to conduct its own performance evaluations. Contractor to provide the following:
 - a. Anticipate this effort and provide access to and use of the overall process system for this purpose.
 - b. Provide laboratory testing services as further described herein

- c. Provide polymer product for startup and performance evaluations as described elsewhere in these specifications.
- 3. Sludge conveyance equipment: belt speed, emergency stop, conveyance of solids without loss along route of travel, release of solids at end of belt.
- 4. Polymer preparation equipment: conveyance of dry product from loading bin to jet mix device, verification of automated monitoring, control, and alarm annunciations.
- F. Operation Period: The operation period begins when the facility has been successfully started up as defined under Paragraph Startup Test Period and has met all Substantial Completion requirements.
- G. Significant Interruption: May include any of the following events:
 - 1. Failure of CONTRACTOR to maintain qualified onsite startup personnel as scheduled.
 - 2. Failure to meet specified performance for more than 2 consecutive hours.
 - 3. Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within 5 hours after failure.
 - 4. Failure of noncritical unit systems, or subsystem that is not satisfactorily corrected within 8 hours after failure.
 - 5. As may be determined by OWNER.
- H. Control System Commissioning: Testing and Commissioning administered by the CONTRACTOR, equipment manufacturers and the CONTRACTOR'S System Integration Services Provider (System Integrator) following Functional Tests and Performance Tests by the CONTRACTOR and OWNER.
- I. Startup Test Period:
 - 1. Startup of the entire facility or any portion thereof includes coordinated operation of the facilities by the CONTRACTOR, Subcontractors, OWNER, operating personnel, and manufacturers' representatives for equipment items and systems after all required Functional Tests have been completed and those Performance Tests deemed necessary for the safe operation of the entire and/or upgraded facility have been completed.
 - 2. Startup of the entire facility or any portion thereof shall be considered complete when, in the opinion of the OWNER, the facility or designated portion has operated in the manner intended for 3 continuous days without Significant Interruption. This period is in addition to any training, Functional Testing, or Performance Test periods specified elsewhere. A Significant Interruption will require the startup then in progress to be stopped and restarted after corrections are made.
 - 3. The CONTRACTOR'S System Integrator will provide SCADA system programming and commissioning to facilitate operation and monitoring of newly installed equipment during the Startup Test Period.

- J. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment. Examples of Systems on this Project are:
1. Screw Press (OWNER Procured)
 2. Screw Conveyor
 3. Polymer Solution Preparation
 4. Process Pumps
 - a. Polymer dosing pumps
 - b. Digested sludge pumps
 - c. W2 Booster pumps
 5. Process piping and associated valves, operators, and instrumentation

1.4 INSTRUMENTATION AND CONTROLS

A. CONTRACTOR's System Integrator

1. Identification, role, and responsibilities per Section 40 90 00.
2. Configure and calibrate process monitoring and automated control devices.
3. Provide PLC software programming and/or verify equipment manufacturers PLC programming used for automated control and monitoring of this Project's equipment and systems meets Project process control requirements.
4. Provide temporary programming and configuration of equipment and devices as required during construction to facilitate the CONTRACTOR's work and the OWNER's treatment plant operations, and minimize alarms associated with phasing and out-of-service equipment.

B. CONTRACTORS' Instrument Suppliers

1. Responsibilities per Section 40 90 00.
2. Furnish submittals and follow-on O&M manuals for Project process automated monitoring and control devices.

C. CONTRACTOR's Process Control Panel Fabricators

1. Qualifications and responsibilities per Section 40 90 00.
2. Support factory testing services including OWNER witness where specified.
3. Furnish completed panels approved by the OWNER to CONTRACTOR for installation in the Project.

- D. CONTRACTOR's work scope includes but is not limited to:
 - 1. Furnishing and installing new electrical infrastructure hardware such as cabling, raceways, panels, and modifications to existing control panel components.
 - 2. Furnishing and installing new control devices and instrumentation including calibration, on-site configuration and startup testing per Section 40 90 00 PROCESS INSTRUMENTATION AND CONTROLS.
 - 3. Testing of power, communications, and control circuits between Project components.
 - 4. Developing, loading, or troubleshooting automation and control programming for computers, or programmable logic controllers (PLCs) supplied by the equipment manufacturers.
 - 5. Developing a Control System Commissioning plan (which will be reviewed and approved by the OWNER).
- E. The KWWTF does not have a plant-wide SCADA system. The CONTRACTOR's work scope does **NOT** include integrating the Project's sludge dewatering system infrastructure into a plant-wide SCADA system.

1.5 SUBMITTALS

- A. Prepare, deliver, and process submittals under provisions of Section 01 33 00 SUBMITTAL PROCEDURES.
- B. Administrative Submittals
 - 1. Functional and performance test plan for temporary equipment, and replacement equipment and systems. Submit at least 14 calendar days prior to start of related testing.
 - 2. Schedule for Facility Startup to address:
 - a. Completion date for pre-startup activities including scheduled plant shut downs and preparation activities, temporary equipment installation, new equipment installation completion, and pressure testing, as applicable.
 - b. Verification of installation by Manufacturer/Equipment Suppliers.
 - c. Startup and Functional Testing
- C. Quality Control Submittals
 - 1. Certificates of Proper Installation for Installed Equipment
 - 2. Manufacturer's Certificate of Proper Installation and Operation and Manufacturer's Certificate of Training for all equipment which is not furnished by the Owner and installed by the Contractor.

1.6 CONTRACTOR FACILITY STARTUP RESPONSIBILITIES

- A. Complete installation of all systems and equipment identified in the Contract Documents.
- B. Confirm continuity in communications cabling routed between control panels and devices, and voltage and proper rotation of electrically powered devices.
- C. Conduct pressure testing of all wetted systems affected by Project.
- D. Prepare and submit functional and performance testing plans and schedules. Indicate when Equipment Manufacturers' representatives are scheduled to visit the site.
- E. Facilitate System Integrator's efforts to establish control connections to the Project's equipment and processes.
- F. Verify proper installation, adjustment, function, performance, and operation of equipment and systems.
- G. Correct any deficiencies identified before system startup including:
 - 1. Power supply and/or communications connections
 - 2. Direction of movement of rotating equipment
 - 3. Leaks and/or other breaches in installed system integrity
- H. Coordinate the Equipment Manufacturers' schedules to visit the site; review equipment and systems for proper installation; review and coordinate Manufacturer's testing, startup, and training schedule; and assist Equipment Manufacturers with functional and performance testing.
- I. With the exception of OWNER-furnished equipment, provide operations training for the OWNER's staff as part of Manufacturers' startup services.
- J. For each major equipment system event of startup, functional and performance testing, and in support of the OWNER's Control System Commissioning, CONTRACTOR shall provide the following on-site resources:
 - 1. A journeyman pipefitter for a period of three 8-hour (measured as time on the project site) weekday/non-holiday calendar days.
 - 2. A journeyman electrician for a period of three 8-hour (measured as time on the project site) weekday/non-holiday calendar days.
 - 3. CONTRACTOR's project superintendent for a period of three 8-hour (measured as time on the project site) weekday/non-holiday calendar days.
 - 4. Tools, equipment, and miscellaneous materials for the pipefitter and electrician appropriate for undertaking troubleshooting efforts for the systems, equipment, and controls.

1.7 SUPPORT FOR SYSTEM INTEGRATION SERVICES

- A. The CONTRACTOR will provide Instrumentation and Control System commissioning required for manual and automated control of the Project's Systems.
- B. During the Control System Commissioning for the Projects' Systems, the System Integrator will:
 - 1. Be present at the Project site to collaborate with each individual Manufacturer's representative during their onsite inspections and startup activities. Required Manufacturer's Representative onsite services are identified elsewhere in these project specifications, but at a minimum include services for:
 - a. Screw press equipment
 - b. Polymer solution makeup equipment
 - c. Screw conveyor equipment
 - d. Pump equipment
 - 1) Digested sludge pumps
 - 2) W2 Booster pumps
 - 2. Verify performance of process equipment control in both manual and automated control modes functions in accordance with the control requirements of these Project Specifications.
 - 3. Demonstrate the operation and control of the following:
 - a. Screw Press (OWNER Procured)
 - b. Screw Conveyor
 - c. Polymer Solution Makeup
 - d. Process Pumps
 - 1) Digested sludge pumps
 - 2) W2 Booster pumps
 - e. Process piping and associated valves, operators, and instrumentation
 - 4. Document and provide OWNER written notification of any failures in achieving process control performance requirements stipulated in these Project Specifications.
- C. Verification of functional performance of the process instrumentation and control system is the responsibility of the CONTRACTOR:
 - 1. As applicable, confirm operation and control features:
 - a. Pump delivery rate(s)

- b. Permissives for equipment cycling
- c. Emergency stop controls

1.8 OWNER FACILITY STARTUP RESPONSIBILITIES

- A. Review CONTRACTOR's submitted:
 - 1. Functional and performance testing plans and schedules.
 - 2. Schedules for Equipment Manufacturers' site visits and training.
 - 3. Schedule as to when the OWNER's SCADA Control System Commissioning will be required relative to CONTRACTOR's test plans and startup schedules.
- B. Review Equipment Manufacturers' startup plans and training materials submitted by CONTRACTOR.
- C. Witness each functional or performance test.
- D. Startup Test Period. Operate process equipment with support of CONTRACTOR.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. General:
 - 1. Complete installation of equipment and components identified in the Contract Documents including electrical power, instrumentation and automation communications, process piping, and instrument systems.
 - 2. Complete and secure certificates of approval for installed components from Manufacturer's Representatives for CONTRACTOR furnished installed equipment and components.
 - 3. Furnish qualified Manufacturers' Representatives at the site to provide Manufacturers' Services per Section 01 43 33 MANUFACTURERS' FIELD SERVICES for the following:
 - a. Screw Press (OWNER Procured)
 - b. Screw Conveyor
 - c. Polymer Solution Makeup
 - d. Process Pumps

- 1) Digested sludge pumps
 - 2) W2 Booster pumps
4. Designate and furnish one or more persons (Instrumentation Supplier) to be responsible for coordinating and expediting CONTRACTOR's Facility Startup duties. The person or persons shall be present during facility startup meetings and shall be available at all times during the Facility Startup period.
 5. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing
- B. Cleaning and checking:
1. Prior to starting Functional Testing:
 - a. Calibrate testing equipment
 - b. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.
 - c. Lubricate equipment in accordance with manufacturers' instructions.
 - d. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
 - e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
 - f. Check power supply to electric-powered equipment for correct voltage.
 - g. Adjust clearances and torques.
 - h. Test piping and pressure operated equipment for leaks. Correct leaks and re-test infrastructure to confirm no leaks occur.
 - i. Obtain completion of applicable portions of Manufacturer's Certificate of Proper Installation.
- C. Ready-to-test determination will be by OWNER based at least on the following:
1. Notification by CONTRACTOR of equipment and system readiness for testing.
 2. Acceptable testing plan.
 3. Acceptable Operation and Maintenance Manuals.
 4. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.
 5. Availability of Equipment Supplier's Representative to assist in inspection and testing of installed equipment.
 6. Equipment and electrical tagging complete.

7. All spare parts and special tools delivered to OWNER.

3.2 FUNCTIONAL TESTING - GENERAL

- A. Begin testing at a time mutually agreed upon by OWNER, Equipment Supplier, and CONTRACTOR.
- B. Notify in writing OWNER and Representative(s) at least 10 days prior to scheduled date of Functional Tests.
- C. Separate items of equipment demonstrated to function properly during subsystem testing may require no further Functional Test if documentation of subsystem testing is acceptable to OWNER.
- D. Conduct Functional Tests as specified for each equipment item or system.
- E. Provide the following:
 1. As a condition of Substantial Completion, demonstrate all operational features and instrumentation and control functions while in manual operational mode
 2. Prior to Final Completion, assist OWNER's System Integration Service Provider in functional verification of all process operational features, and instrumentation and control functions while in an automated operational mode
- F. Performance Testing shall not commence until the equipment or system meets the specified Functional Tests.

3.3 PERFORMANCE TEST - GENERAL

- A. Begin testing at times mutually agreed upon by OWNER and CONTRACTOR.
- B. OWNER will be present during tests. Notify in writing OWNER and Manufacturer's Representative(s) at least 14 days prior to scheduled date of Functional Tests.
- C. Conduct performance tests as specified for each equipment item or system. Testing requirements for CONTRACTOR furnished and installed systems and/or equipment are identified within the Project specification sections for those systems/equipment.
- D. Unless otherwise indicated, furnish all labor, materials, and supplies for conducting the test and taking all samples and performance measurements.
- E. Prepare Performance Test report summarizing test method. Include test logs, pertinent calculations, and certification of performance.

3.4 PERFORMANCE TESTING FOR OWNER FURNISHED SCREW PRESS

- A. The CONTRACTOR will support the OWNER in efforts to complete performance testing for the OWNER-furnished, CONTRACTOR-installed screw press equipment. Support provided by the CONTRACTOR is to include the items below.
- B. Provide labor for the following:
 - 1. Coordinate with OWNER on performance test plan details including schedule and procedures.
 - 2. Prepare polymer solution for screw press operations in accordance with Screw Press manufacturer's recommendations
 - 3. Confirm digested sludge delivery rates displayed at FIT-1-1 accurately represent sludge flow to new screw press.
 - 4. Coordinate with water quality laboratory to
 - a. Secure laboratory analytical services
 - b. Secure laboratory sample kits for performance testing
 - c. Confirm schedule for lab analytical services compatible with laboratory personnel availability schedules
 - 5. Deliver laboratory issued sample kits to Project site for performance testing
 - 6. Refrigerate ice packs provided by lab for use in maintaining cool sample kit temperatures while in return shipping to laboratory.
 - 7. Initiate screw press operations.
 - 8. Collect performance test samples.
 - a. Three each grab samples of digested sludge feed to screw press prior to polymer conditioning. Schedule sample collection to be hourly during the first four hours of press operation with the first sample collected 60 minutes after initiating press operations. Analyze for
 - 1) Total Solids
 - 2) Volatile Solids
 - b. Three each grab samples of screw press pressate released from screw press during 4-hour performance testing. Collect samples hourly during the first four hours of press operation with the first sample collected 60 minutes after initiating press operations. Analyze for
 - 1) Total Solids
 - c. Three each grab samples of screw press cake released from screw press during 4-hour performance testing. Collect samples hourly during the first four hours of press

operation with the first sample collected 60 minutes after initiating press operations.
Analyze for

- 1) Total Solids

9. Record polymer use
 - a. Concentration of polymer solution prepared and used for performance testing
 - b. Flow rate of polymer dosing pumps used for performance testing
10. Prepare sample kits for delivery to water quality laboratory
11. Deliver sample kits with test samples to laboratory for sample analysis.
12. Pay for laboratory services provided for screw press performance testing.
13. Provide the OWNER reports of laboratory testing results

C. Provide materials for performance testing

1. Furnish to Project site polymer product in quantity as specified in Section 46 33 33 Polymer Blending and Feed Equipment

3.5 STARTUP ACTIVITIES

- A. Designate and furnish one or more persons (Instrumentation Supplier) to be responsible for coordinating and expediting CONTRACTOR's Facility Startup duties.
- B. When Facility Startup has commenced, schedule remaining Work so as not to interfere with or delay the completion of Facility Startup. Support the Facility Startup activities with adequate staff to prevent delays and process upsets. This staff shall include, but not be limited to, major equipment and system Manufacturers' Representatives, electricians, instrumentation technicians, and plumbers.
- C. Supply and coordinate specified Manufacturer's Facility Startup services.
- D. Make adjustments, repairs, and corrections necessary to complete Facility Startup.
- E. After the facility is operating, complete the testing of those items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to startup test period.

3.6 CONTINUOUS OPERATIONS

- A. OWNER will accept equipment and systems as ready for continuous operation only after successful startup is complete, and reports submitted, and Manufacturers' services completed for training of OWNER's personnel.
- END OF SECTION 01 75 00

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Requirements:
 - 1. Section 01 78 23 - Operation and Maintenance Data
 - 2. Section 01 78 39 - Project Record Documents
 - 3. Section 01 79 00 - Demonstration and Training
 - 4. Division 2 through 46 Sections for specific facility start-up, closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBSTANTIAL COMPLETION PROCEDURES

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 8. Complete startup testing of systems.
 9. Submit test/adjust/balance records.
 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements, except project office may remain and be removed prior to final completion.
 11. Advise Owner of changeover in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of area in sequential order, starting with exterior first.
 2. Organize items applying to each area by major element.

1.5 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 1. Submit by email to Engineer.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - c. Sweep concrete.
 - d. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - e. Remove labels that are not permanent.
 - f. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - g. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - h. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - i. Clean strainers.
 - j. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 01 73 00 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.

1.2 SUBMITTALS

- A. Draft Manuals: Submit one copy of each manual in draft form within 60 days after date Shop Drawings are approved in PDF format but a minimum of 30 days prior to startup operations/operator training. Engineer will return manuals with comments within 15 days after final inspection.
- B. Final Manuals: Correct or modify each manual to comply with Engineer's comments. Submit 3 paper copies and two electronic copies on Compact Disc (CD-ROM) in PDF format.
- C. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 2. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.

- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for type of emergency, emergency instructions, and emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component for fire, flood, gas leak, water leak, power failure, water outage, equipment failure, and chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include instructions on stopping, shutdown instructions for each type of emergency, operating instructions for conditions outside normal operating limits, and required sequences for electric or electronic systems.

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
- B. Descriptions: Include the following:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.

6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

1.7 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1.8 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- D. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions, and demonstration and training videotape if available, that detail essential maintenance procedures:
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

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SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
- B. Related Requirements:
 - 1. Section 01 78 23 - Operation and Maintenance Data

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of full-size marked-up Record Prints.
- B. Miscellaneous Record Submittals: Submit two copies.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Work Change Directive.
 - k. Changes made following Engineer's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

1.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Examples of miscellaneous records include:
 1. Test reports.

2. Inspections by authorities having jurisdiction.

1.5 RECORDING AND MAINTENANCE OF RECORD DOCUMENTS

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

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SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. Provide submittal materials a minimum of 45 days prior to anticipated date of training. Engineer will review and submit to ADEC operator certification program for concurrence. Coordinate training with Operation and Maintenance manual requirements.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Engineer.

1.5 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.

- h. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.

- d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.6 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.7 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

- B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Engineer, with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 79 00

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DIVISION 03

CONCRETE

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SECTION 03 30 00 - CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

Cast in place concrete required for this project is shown in the Drawings and includes, but is not necessarily limited to footings, foundation walls, slabs on grade, floor slabs, concrete tanks, and concrete reinforcement.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

In general, all concrete work on this Project shall comply with current American Concrete Institute Manuals of Concrete Practices. Comply with all applicable codes and regulations and pertinent portions of the following referenced standards and other standard publications referenced in subsequent articles, which shall become a part of these specifications to the extent of their applicability to the particular product, system, assembly, or item specified:

1. ACI 301: "Specifications for Structural Concrete for Buildings".
2. ACI 302: "Guide for Concrete Floor and Slab Construction."
3. ACI 304: "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete."
4. ACI 311: "Recommended Practice for Concrete Inspection".
5. ACI 315: "Manual of Standard Practice for Detailing Reinforced Concrete Structures."
6. ACI 318: "Building Code Requirements for Reinforced Concrete".
7. ACI 347: "Recommended Practice for Concrete Formwork".

B. Conflicts:

In the event of conflict or inconsistency between or among referenced standards and any provisions of this specification, or other Contract Documents, the most stringent requirement shall prevail, and shall be enforced.

C. Testing:

1. Conduct tests of the concrete during construction in accordance with ACI 301. Submit results of tests for approval. Remove and replace concrete which fails to achieve minimum 28 day compressive strength shown on the Drawings, at Contractor's expense.
2. Test all concrete for footings, slabs, walls, curbs and sidewalks.
3. Reject concrete which fails to meet specified criteria for slump, air content, and temperature.

D. Frequency of Testing:

1. Slump tests - ASTM C-143:
Perform one test for each set of compressive strength test specimens.
2. Air content - ASTM C-231:
Perform one test for each set of compressive strength test specimens.
3. Concrete temperature:
Test hourly when ambient air temperature is 40°F and below, and each time a set of compression test specimens are made.
4. Compression test specimen - ASTM C-31:
One set of three standard cylinders for each compressive strength test. Field cure.
5. Compressive strength tests - ASTM C-39:
Samples for strength tests for each class of concrete placed each day shall be taken not less than one a day nor less than once for each 20 cu. yd. of concrete, nor less than once for each 1,000 sq. ft. of surface area for slabs.

1.3 SUBMITTALS

Make all submittals in conformance with applicable section of these specifications. Conform with ACI 315 for nomenclature and conventions used in shop and placement drawings:

A. Concrete Materials:

Submit concrete design specification, laboratory test results, and materials list showing source and gradation of all aggregates, type and brand of Portland cement, admixtures source and quality of mixing water, and other aspects of the concrete design.

B. Reinforcing Steel:

Provide Materials Certificates signed by manufacturer and Contractor certifying that each material item complies with, or exceeds, specified requirements.

C. Admixtures:

Provide Materials Certificates signed by manufacturer and Contractor certifying that each material item complies with, or exceeds, specified requirements and that chloride content complies with specification requirements.

D. Delegated Design Submittal:

Provide Design Details including seismic structural anchorage calculations and details, stamped and sealed by a professional engineer registered in the state of Alaska for housekeeping pads shown on the plans.

1.4 PRODUCT HANDLING

A. Delivery and Storage:

Do not permit delivery of any of the products of this section to the project site until proper facilities, away from traffic, are available for their proper storage and which will permit sorting and handling without endangering the materials themselves or materials for installations of other sections. Store all reinforcing steel on wood dunnage to keep it from direct contact with the ground surface.

B. Repairs & Replacements:

In the event of damage make all repairs and replacements necessary to restore to undamaged condition and do not proceed in those areas until all repairs have been made. Repairs and replacements shall be subject to approval of the Contracting Agency and shall be accomplished at no additional expense to the Owner.

1.5 PROJECT CONDITIONS

A. Protection Against Freezing:

Cover work with temporary or permanent cover as required to protect concrete against possibility of freezing during placement of concrete, and for at least 14 days after placement of concrete.

PART 2 - PRODUCTS

2.1 FORMS

A. Material:

Provide new, except as permitted in PART 3 of this section for re-use:

1. Plywood:

U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill oiled and edge sealed, with each piece bearing legible grade mark of a recognized and approved inspection agency.

2. Dimensional lumber:

Him-Fir Number two grade, seasoned

B. Ties and Spreaders:

1. Provide type providing minimum working strength of 3,000 lbs. when fully assembled, which does not leave open holes through the concrete, and which permits neat and solid patching.
2. Metal shall not be closer than 3/4" to surface when forms are removed.
3. Do not use wire ties and wood spreaders.

C. Alternate Forming Systems:

Alternate systems will be considered upon submittal.

D. Coatings and Parting Compounds:

Provide commercial fabrication that will not bond with stain or adversely effect concrete surfaces and will not impair subsequent treatment of concrete surfaces to be cured with water or compounds conforming to FSTT-3-001657.

E. Joint Fillers:

Provide premolded, resilient, waterproof, compressible type with minimum 75% recovery conforming to FS HH-F- 341E, Type II; 1/2" thick for interior joints and 1/2" thick for exterior walks.

G. Other Materials:

Provide all other materials required for complete installation as selected by Contractor subject to the approval of the Contracting Agency.

2.2 REINFORCING

All concrete reinforcement shall be new, free from rust, and shall comply with the following reference standards:

A. Reinforcing Bars:

Provide ASTM A-615 grade 60 except where noted otherwise.

B. Wire:

Provide ASTM A-82 #16 double annealed iron wire.

C. Welded Wire Fabric:

Provide ASTM A-185 in Flat Sheets.

D. Accessories and Supports:

Provide supports, bolsters, chairs, spacers and other devices and accessories conforming to recommended Concrete Reinforcing Steel Institute (CRSI) practices. Provide galvanized accessories within 1-1/2" of surface of concrete with plastic tip chairs for exposed finish surfaces. Concrete dobie or other block, brick, or wood supports will not be permitted, except where specifically noted.

E. Welding Electrodes:

Conform to AWS Code D12.1.

F. Other Materials:

Provide all other materials, not specifically described but required for a complete and proper installation of concrete reinforcement, as selected by the Contractor, subject to the approval of the Contracting Agency.

2.3 CONCRETE

A. General:

Concrete mixes shall be designed to produce the tabulated properties below, and shall be subject to the approval of the Owner's Representative.

B. Quality:

1. Provide concrete having 3,000 psi minimum 28 day compressive strengths for footings, walls and slabs, unless noted otherwise in drawings.

2. Provide concrete with maximum aggregate of 3/4" for all concrete except concrete for exposed aggregate surfaces, which shall have a maximum aggregate size of 3/8".
3. Slump at placement shall conform to the following:

		Concrete Without Super Plasticizer	Concrete with Super Plasticizer
<u>Location</u>			
a.	Slab on Grade	3 inches	6 to 9 inches
b.	Footings, Walls, Slabs and Beams	4 inches	6 to 9 inches

4. Entrained air content at placement shall be 6% with 1.5% tolerance.

C. Cement:

Provide portland cement conforming to ASTM C-150, type I or II the product of a single manufacturer.

D. Aggregates:

1. Provide aggregates conforming to ASTM C-33, current edition, except as expressly permitted by the Contracting Agency.
2. Course aggregate size shall not exceed one-fifth the narrowest dimension between forms, one-third the depth of slabs, nor three-fourths the minimum clear spacing between individual bars or bundles of bars.
3. Fine aggregates shall be clean, sharp, natural sand, free from loam, clay, lumps, alkali, organic matter, or other deleterious substances.
4. Aggregates shall be well graded, clean, hard gravel and coarse sand, non-frost susceptible material, and free of vegetable matter and coatings of silt or clay. The gradations shall be determined by standard laboratory sieves with square openings. Material retained on a No. 4 screen shall be classified as coarse aggregate, which shall conform to the requirements of AASHTO M-80 and have the following limits of gradation:

COARSE AGGREGATE FOR CONCRETE

Designated Sizes (AASHTO Gradation)	Percent by weight passing Laboratory Sieve having square openings in inches						
	2	1-1/2	1	3/4	1/2	3/8	No.4
No.67 (3/4" to No.4)	..	..	100	90-100	..	20-55	0-10*

*Not more than 5% shall pass a No. 8 sieve.

All material passing a No. 4 sieve shall be classified as fine aggregate and shall conform to the requirements of AASHTO M-6 and have the following gradation:

FINE AGGREGATE FOR CONCRETE

SIEVE SIZE	PERCENT PASSING SIEVE
Passing a 3/8 inch sieve	100
Passing a No. 4 inch sieve	95-100
Passing a No. 8 inch sieve	80-100
Passing a No. 16 inch sieve	45-80
Passing a No. 30 inch sieve	25-60
Passing a No. 50 inch sieve	10-30
Passing a No. 100 inch sieve	2-10

E. Water:

Provide mixing water from an approved source, clean, fresh, and free of acids, alkalis, oil, organic or other deleterious matter.

F. Miscellaneous Inserts:

Provide ASTM A-36 steel.

G. Air Entrainment:

Comply with ASTM C-260.

H. Water Reducing Admixture:

Comply with ASTM C-494.

I. Epoxy Grout:

Provide Master Builder's "Masterflow 713", Sonneborn "Ferrolith", or approved equal.

J. Joint Sealer:

Provide Grace "Daraweld-U Traffic Grade" or approved equal.

K. Other Materials:

Provide all other materials not specifically described but required for a complete and proper concrete installation, as selected by Contractor and subject to the approval of the Contracting Agency.

- L. Calcium chloride additives are not permitted.
- M. Latex - cement leveling compound - Laticrete 4237 or approved equal.
Provide a smooth trowel finish to accept finishes as scheduled.
- N. Curing Compound:

Curing compounds are not allowed. All surfaces shall be water-cured.
- O. Superplasticizers:
 - 1. Meet ASTM C 494, Type F or G, of second or third generation type.
 - 2. Do not use first generation superplasticizer
 - 3. Hold slump to 6" or greater for 2 hours.
 - 4. Second Generation Superplasticizer: Batch plant added to extend plasticity time up to 2-1/2 hours, control temperature of fresh concrete, reduce water 20 to 30 percent, and give higher strengths at all ages.
 - 5. Third Generation Superplasticizer: Batch plant added to extend plasticity time up to 2-1/2 hours, maintain setting characteristics similar to normal concrete throughout its recommended dosage range and at varying concrete temperatures, reduce water to 30 to 40 percent, and give high-early and ultimate strengths.
 - 6. Manufacturer and Product:
 - a. Master Builders, Inc., Cleveland, OH, Rheobuild
 - b. W.R. Grace & Co., Cambridge, MA, Darecem 100.
- P. Synthetic Fiber Reinforcement for Concrete Slabs:
 - 1. 'Genesis Fiber' collated fibrillated polypropylene synthetic fiber. Add to mix at a rate of 0.1% by volume.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

- A. Inspection:

Examine the surface of areas to which the concrete work is to be applied and determine that prior work complete, that all subgrades have been properly compacted, graded, that all slab cushions are

in place, and that all previous work is complete and ready for erection of forms, setting of reinforcement, and placement of concrete.

B. Discrepancies:

In the event of discrepancy, ambiguity, interference, or any other unanticipated condition which might impede the timely execution of the work of this section, promptly notify the Contracting Agency and do not proceed in the area of discrepancy until all questions in regard thereto have been resolved.

C. Certificates:

Obtain written acknowledgment(s) from the subcontractors or installers of the formwork, reinforcement, and concrete placement that the substrates affecting their work have been examined and found satisfactory for subsequent operations. Such acknowledgments countersigned by the Contractor and delivered to the Contracting Agency prior to the final inspection, shall be a condition of the acceptance of the work of this section.

D. Admixtures:

Superplasticizers:

1. Add at concrete plant only through equipment furnished and/or approved by admixture manufacturer.
2. Equipment shall provide for easy and quick visual verification of admixture amount used for each dose.
3. Discharge amount to be added to each load of concrete into separate dispensing container, measured verified as to amount, then add to concrete.
4. Redosing of Concrete: Not permitted except when approved by inspection agency monitoring concrete quality and only after quality tests show this practice does not decrease the quality specified for concrete.

3.2 NOTICE

Notify the Owner's Representative at least 48 hours prior to beginning any pour of concrete, or 24 hours prior to closing any forms.

3.3 FORMWORK

A. Design:

Design forms to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure, so that they may be readily removed without impact, shock, or damage to in place concrete and adjacent materials.

B. Construction:

1. Construct forms to conform with ACI 347, to sizes, shapes, lines, and dimensions shown or as required to obtain accurate alignment, location, grades, and level and plumb work in finished structure. Forms shall be set straight, plumb and true to within 1/4" in 10' of length.
2. Provide for openings, offsets, recesses, linkages, keyways, moldings, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required to attain the required configuration.
3. Use materials selected to achieve the indicated finishes. Solidly butt joints and provide back up to prevent leakage of cement paste.
4. Fabricate for easy removal without hammering or prying against concrete surfaces. Provide crush plates where stripping might damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
5. Where interior area of formwork is inaccessible, provide temporary openings for cleanout, inspection prior to concrete placement, and for final placement. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
6. Chamfer exposed corners and edges as shown or required using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

C. Form Ties:

Use factory fabricated, adjustable length, removable or snap-off metal form ties, designed to prevent form deflection, and prevent spalling concrete surfaces upon removal. Position ties so portion remaining within concrete after removal is at least 1-1/2" inside the concrete and which will not leave holes larger than 1" diameter in the concrete surface.

D. Coordination With Other Trades:

Provide necessary coordination with other trades to determine size and location of openings necessary for work of those trades. Accurately place and securely support items built into forms.

E. Cleaning & Tightening:

Thoroughly clean forms and adjacent surfaces receiving concrete. Remove chips, wood, sawdust, dirt, and other debris prior to placement of concrete. Retighten forms after concrete placement if required to eliminate mortar leaks.

3.4 PLACING REINFORCEMENT

A. General:

Comply with specified codes and standards and CRSI recommended placing practices for details and methods of placing reinforcement and supports.

B. Cleaning:

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

C. Positioning:

1. Support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
2. Place reinforcement to obtain the minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold in position during concrete placement. Set wire ties so ends are directed into concrete, not toward exposed surfaces.
3. Do not place reinforcing bars more than 2" beyond the last leg of continuous bar support. Do not use supports as bases for runways for conveying equipment or similar construction loads.

D. Welded Wire Fabric:

1. Install welded wire fabric. Mats only. No rolled material will be acceptable. Lap adjoining mats a minimum of one and one half meshes and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps.
2. Support welded wire fabric with plastic chairs at intervals not exceeding 4 feet measured along both directions of the mesh. Support welded wire fabric to the middle of the slab thickness.
3. The practice of lifting the welded wire fabric off the subgrade as concrete is poured will be allowed only if after lifting the wire it is supported per Item D, 2 above.

3.5 JOINTS

A. Construction Joints:

Locate and install construction joints which are not shown on the drawings so as not to impair the strength and appearance of the structure, subject to the approval of the Contracting Agency.

Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints.

B. Keyways:

Provide keyways at least 1-1/2" deep in all construction joints in walls, slabs, and between walls and footings; approved bulkheads designed for this purpose may be used for slabs.

C. Contraction Control Joints:

Construct preformed contraction control joints in slabs to form panels of patterns as shown on the drawings.

D. Expansion:.

1. Expansion joints:

Expansion joint material shall conform to the requirements at ASTM D-994 and AASHTO M-33. Expansion joint material shall extend the full width of the structure and shall be cut to such dimensions that the base of the expansion joint shall extend to the subgrade and the top shall be depressed not less than one-quarter (1/4) inch nor more than one-half (1/2) inch below the finished surface of the concrete.

The material shall be of one (1) piece in the vertical dimension and shall be securely fastened in a vertical position to the existing concrete face against which fresh concrete is to be poured. After the concrete has set, the expansion joints shall be filled flush to the finish concrete surface with asphalt cement, two hundred (200) to three hundred (300) penetration. Application temperature of the sealing asphalt shall be between 250 degrees and 350 degrees Fahrenheit.

Sealing asphalt shall be applied by pouring from a bucket with a V-shaped spout, equipped with a positive shutoff to prevent spilling or dripping of asphalt. Before sealing, the joint shall be cleaned of all dirt, gravel, concrete mortar or other extraneous material. Sealing shall be done in a neat workmanlike manner. Sloppy work in sealing of expansion joints will not be tolerated.

3.6 EMBEDDED ITEMS

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

3.7 PREPARATION OF FORMS

Coat the contact surfaces of forms with an approved coating compound before placement of concrete, and according to manufacturer's instructions. Thin only with approved thinners according to manufacturer's recommendations. Do not permit application of excessive coating compound or allow it to accumulate in the forms or come into contact with concrete surfaces against which fresh concrete will be placed.

Coat steel forms with a non-staining, rust preventative form oil or otherwise protect against rusting. Rust stained steel formwork will not be acceptable and will be rejected.

3.8 CONCRETE PLACEMENT

A. Pre-placement Inspection:

Before placement of concrete, inspect the formwork and reinforcement and verify that all prior work has been completed to the point that placement of the concrete may be executed in complete conformance with the original design, the approved submittals and the referenced standards. Determine that all embedded items, supports, backing, and other provisions for items supported by or attached to the concrete have been provided for. Coordinate with other trades whose work will be affected by the operations of this section. Obtain all written acknowledgments specified in 3.01C above.

B. General:

Comply with ACI 304 and as herein specified. Deposit continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified in 3.05. Deposit concrete as nearly as practicable to its final location to avoid segregation due to re-handling or flowing.

C. Footings and Walls:

1. Deposit in forms in horizontal layers not exceeding 24" in depth and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while previous layer is still plastic to avoid cold joints. Where vertical drop is more than three feet, elephant trunks shall be used.

3. Consolidate by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309 to suit type of concrete and project conditions.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the placed layer and at least 6" into the previous layer. Do not insert vibrators into lower layers of concrete that have begun to set. Limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.

D. Slabs:

1. Deposit and consolidate in a continuous operation within the limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate by previously specified methods, working concrete around reinforcement, embedded items, and into corners.
3. Bring slab surfaces to the correct level with a straight edge and strikeoff. Use bull floats or darbies to smooth the surface, leaving it free of humps and hollows. Do not sprinkle water onto the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.
4. Maintain reinforcing in the proper position during all placement and consolidating operations.

E. Sidewalks, Curb and Gutters:

Concrete shall be handled from transport vehicle to the place of final description in a continuous manner as rapidly as practicable. The rate of placement shall not exceed the rate at which the various placing and finishing operations can be performed in accordance with these specifications. Where the vertical drop is more than three (3) feet, elephant trunks shall be used.

If concrete is to be placed by the extruded method, the Contractor shall demonstrate to the satisfaction of the Contracting Agency that the machine is capable of placing a dense, uniformly compacted concrete to exact section, line and grade.

F. Cold Weather Placement:

Protect placed concrete from physical damage or reduced strength which could be caused by frost, freezing action, or low temperatures, in compliance with ACI 306 and as follows:

1. When ambient temperature has fallen to or is expected to fall below 40°F., uniformly heat water and aggregates prior to mixing to maintain mixture temperature not less than 50°F. and not more than 80°F. at point of placement.
2. Do not use frozen materials or materials containing ice or snow and do not allow concrete to be placed on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other material containing anti-freeze agents or chemical accelerators unless specifically permitted by the Contracting Agency for the particular situation encountered.

3.9 FINISHING FORMED SURFACES

A. Rough Form Finish:

For formed surfaces not exposed to view in the finish work or by other construction, unless otherwise indicated, provide a surface having the texture imparted by the form facing material used with tie holes and defective areas repaired and patched and fins and other projections chipped down and rubbed off.

B. Smooth Form Finish:

For formed surfaces exposed to view, or that are to be covered with a coating or covering material applied to or bonded directly to the concrete, such as waterproofing, damp proofing, painting or other similar system, provide a surface obtained by selecting form facing material, arranged symmetrically orderly with a minimum of seams. Repair and patch defective areas with fins and projections completely removed and smoothed.

C. Smooth Rubbed Finish:

Provide smooth rubbed finish which has received smooth form finish treatment not later than the day after removal of the forms. Moisten the surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is attained. Do not apply cement grout other than the created by the rubbing process.

D. Grout Cleaned Finish:

Provide grout cleaned finish as scheduled to surfaces which have received smooth form finish by combining one part of portland cement to 1-1/2 parts fine sand by volume, and mixing with water to the consistency of thick paint. Blend standard portland cement and white portland cement in amounts determined by trial patches so that final color of dry grout will closely match adjacent surfaces. Thoroughly wet concrete surfaces and apply grout immediately to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

E. Related Unformed Surfaces:

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

3.10 SLAB FINISHES

A. Scratch Finish:

Where scheduled or shown provide scratch finish on monolithic slab surfaces that are to receive topping or mortar setting beds for tile, terrazzo, or other bonded cementitious finishes.

After placement of slab, plane surface to a tolerance not exceeding 1/4" in 24". Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, rakes, or brooms.

B. Float Finish:

Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes described in subsequent paragraphs, and surfaces which are to be covered by membrane or elastic waterproofing, roofing, or other finishes as scheduled.

After screeding and consolidating concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit floating of surface. Consolidate surface with power or hand floats or both, using hand floats in small or inaccessible areas. Float surface to a tolerance not exceeding 1/4" in 10' when tested with a 10' straight edge. Cut down high spots and fill in low spots by floating. Do not apply cement or cement and sand mixture for filling in, use only grout removed from high spots. Uniformly slope to drains. Immediately after leveling refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish:

Apply trowel finish to slab surfaces that are to be exposed to view and surfaces that are to be covered by resilient flooring, paint, or other thin-film finish systems.

After floating, begin first troweling operation with power driven or hand trowels. Begin troweling when surface produces a ringing sound as trowel is moved over surface. Hand trowel as necessary to obtain a smooth surface free of trowel marks and of a uniform texture and appearance, and with a tolerance not exceeding 1/8" in 10' when tested with a 10' straightedge.

D. Broom Finish:

Apply broom finish to exterior and interior platforms, steps, stoops, walks, and ramps, and elsewhere as shown or scheduled.

Immediately after trowel finishing, slightly roughen surface by brooming with a fiber bristle broom perpendicular to direction of travel. Coordinate final finish with Contracting Agency before application.

E. Chemical Hardener/Sealer Finish:

Apply chemical hardener/Sealer finish to interior floors, after complete curing and drying of the concrete surface. Chemical hardeners shall be coordinated with adhesive to be used in conjunction with other flooring materials.

1. Apply uniformly, using a garden-type sprayer, industrial sprayer or roller.
2. Do not add a thinner.
3. When using a short-nap roller, if the rolling action starts to create tiny bubbles on the surface, slow down the rolling motion.
4. Do not overlap; avoid thick applications.
5. Do not "pull" the material when applying.
6. Application rate 350 S.F./gallon.

F. Exposed Aggregate:

1. Provide exposed aggregate surface at locations indicated in the Drawings.
2. Concrete with a maximum slump of 3" shall be used in exposed aggregate areas. Air entrainment shall be in accordance with specifications.
3. Aggregate shall be 3/8" maximum.
4. Screed concrete to proper level. Do not jitterbug or tamp concrete.
5. Floating shall be limited to amount required to ensure that aggregate is surrounded and only slightly covered by mortar, leaving no holes in the surface.
6. Shortly after floating, Masterbuilders Confilm surface retarder may be sprayed over the surface to allow sufficient time to elapse before exposing operation begins.
7. Exposing operation should begin as soon as brushing and hosing of the surface can be done without over-exposing or dislodging the aggregate. Finishers are to stay off the newly

exposed surface to avoid breaking the aggregate bond. If it is necessary for finishers to move about on the newly exposed surface, kneeboards are to be used. Kneeboards shall be gently placed on the surface, and shall not be slid or twisted when on the surface.

8. Exposed aggregate slabs shall be cured thoroughly.

3.11 CURING & PROTECTION

A. General:

Protect freshly placed concrete from premature drying and excessive cold, and maintain without drying at a relatively constant temperature for a period of time necessary for hydration of cement and proper hardening. Conduct all curing operations in compliance with ACI 301 & ACI 308.

1. Initiate curing process as soon as free water has disappeared from the concrete surface. Weather permitting, keep continuously moist for not less than 72 hours.
2. Begin final curing procedures immediately following initial curing and before concrete has dried.
3. Continue curing for a minimum of 10 days after initial placement unless otherwise permitted in writing by Contracting Agency.
4. Avoid rapid drying at end of curing period.
5. Maintain concrete surface temperature at least 50°F. for 7 days after following placement of concrete. At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

B. Curing Methods:

1. Moisture Curing:
 - a. Keep concrete surface continuously wet by covering with water or continuous fog spray.
 - b. Cover concrete surface with specified absorptive cover, thoroughly saturated with water, and keeping continuously wet. Place absorptive cover to provide coverage at edges, with 4" lap over adjacent absorptive covers.
2. Moisture-cover Curing:

Cover concrete surfaces with moisture retaining cover, placed in widest practicable width with sides and lapped a minimum of 3" and sealed with waterproof tape or adhesive. Immediately

repair any holes or tears occurring during curing period using cover material and waterproof tape.

3. Membrane Curing:

Do not use membrane curing compounds.

C. Formed Surfaces:

Cure formed surfaces including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above as applicable.

D. Unformed Surfaces:

Cure formed surfaces such as slabs, floor topping and other similar flat surfaces by application of the approved curing method.

Use moisture retaining curing method for surfaces which are to receive liquid floor hardener or finish flooring, unless otherwise specifically directed in writing by the Contracting Agency.

3.12 FORM REMOVAL

A. Non-Supporting Forms:

Formwork not supporting concrete, such as sides of footings, may be removed after cumulatively curing at not less than 50°F. for a minimum of 24 hours after placement, provided concrete has sufficiently hardened not to be damaged by removal operations, and providing curing operations are maintained.

B. Supporting Forms:

Formwork supporting weight of concrete such as beam soffits, joints, slabs and other similar structural elements shall not be removed in less than 14 days, and not until design minimum compressive strength for 28 days has been attained, as determined by testing of field cured specimens representative of actual location of the members in question

C. Metal decking forms shall be left in place.

3.13 RE-USE OF FORMS

Re-use of forms will be permitted only under the following conditions, subject to the approval of the Contracting Agency in each instance:

- A. Clean and repair all contact surfaces to achieve capability equal to that of new forms.
- B. Split, frayed, delaminated, or otherwise deteriorated facing or supporting materials will not be permitted.
- C. Apply new coating compound to contact surfaces as specified for new work.
- D. Where forms are extended for successive placement, thoroughly clean all surfaces and tighten to close joints. Align and secure joints to avoid offsets.
- E. Do not use "Patched" forms for expressed surfaces unless specifically permitted in writing by Contracting Agency in each particular instance.

3.14 SURFACE REPAIRS

A. General:

Repair and patch defective areas with cement mortar immediately after removal of forms, but only when acceptable to Contracting Agency.

- 1. Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete, but in no case greater than 1".
- 2. Make edges of cuts perpendicular to the concrete surface.
- 3. Dampen the area to be patched with water and brush coat with neat cement grout or proprietary bonding agent.

B. Exposed to View Surfaces:

- 1. Blend white portland cement and standard portland cement so that when dry patching mortar will match color of surrounding surface. Provide test areas at inconspicuous location to verify match.
- 2. Compact mortar in place and stake off slightly higher than surrounding surface.
- 3. Apply appropriate finish as provided in 3.09.

C. High Areas:

Correct high areas by grinding, after concrete has cured at least 14 days.

D. Low Areas:

Correct low areas during or immediately after completion of surface finishing operations by cutting out the low area and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used upon approval of the Contracting Agency.

E. Other Repairs:

1. Repair defective areas, except random cracks and single holes not exceeding 1" dia. by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete, and brush with neat cement grout coating or concrete bonding agent. Mix patching concrete of same materials to provide concrete of the same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
2. Repair isolated random cracks and single holes not over 1" in dia. by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose cement grout coating or concrete bonding agent. Mix dry-pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing #16 screen, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

F. Other Methods:

Repair methods not specified may be used, subject to the approval of the Contracting Agency.

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DIVISION 05

METALS

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SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

Structural metal framing for this Work is indicated in the Drawings and includes but is not necessarily limited to:

1. Beams
2. Bases
3. Columns
4. Structural Steel Accessories

1.2 QUALITY ASSURANCE

A. Qualifications of Suppliers and Personnel:

1. For the fabrication of the structural steel employ only a firm regularly established in the fabrication of structural steel.
2. For the erection of the structural steel employ only a firm regularly established in the erection of structural steel.
3. For welding of structural steel, (except for welds which do not carry calculated stresses) employ only welders who are currently qualified as prescribed in "Qualification Procedure" of the American Welding Society.
4. Credentials of welders are to be presented to the Owner's Representative prior to work starting. Credentials to include current welders certificate indicating type of test, position of welds, etc.

B. Codes and Standards:

In addition to complying with all pertinent codes and regulations, comply with:

1. "Specifications for the Design Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.
2. "Code for Welding in Building Construction" of the American Welding Society.

1.3 SUBMITTALS

- A. Provide certificates of compliance with referenced standards, and certification of selected fabricator's and erector's qualifications.
- B. Provide shop drawings for all structural steel.
- C. Provide engineered design for field splices, with shop drawings stamped by a Structural Engineer licensed to practice in the State of Alaska.

1.4 PRODUCT HANDLING

Do not deliver any of the structural steel to the jobsite until a secure area away from traffic is available for its storage, permitting its sorting and handling without endangering other stored materials. Take all measures necessary to protect the structural steel from damage and to protect the installed work and materials of all other trades.

In the event of damage to either the structural steel, or to other materials or work, make all repairs and replacements necessary to restore the original undamaged conditions. Repairs and replacements shall be subject to the approval of the Architect and shall be accomplished at no additional expense to the Owner.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

- A. Shapes and Plates:
Provide steel plates and shapes conforming to ASTM A-36, (Fy) = 36ksi.
- B. Wide Flange Beams:
Provide wide flange beams conforming to ASTM A992, (Fy) = 50ksi.
- C. Rectangular Tubing:
Provide rectangular steel tubing complying with ASTM A-500, Grade B with yield strength (Fy) = 46 ksi.

2.2 BOLTS AND NUTS

- A. Machine and Anchor Bolts:
Comply with ASTM A-307.

2.3 PRIMER PAINT

Provide primer paint which is compatible with finish coatings where specified. Where no finish coating is specified, provide primer complying with FS TT-P-31D.

2.4 OTHER MATERIALS

All other materials, not specifically described but required for a complete and proper installation of structural steel shall be new, free from rust, first quality of their respective kinds, and subject to the approval of the Architect.

PART 3 - EXECUTION

3.1 FABRICATION

A. General:

Fabricate all structural steel in strict accordance with the approved shop drawings and the referenced standards.

B. Shop Cleaning and Priming:

1. Shop paint all structural steel one coat except steel to be encased in concrete and surfaces requiring field welding.
2. Thoroughly clean all steel for concrete encasement.

3.2 WELDING

Unless Otherwise Specifically Noted:

- A. Follow applicable portions of American Welding Society specifications in all welds.
- B. Use ASTM A-233, E-60, or E-70 electrodes. Store electrodes in on site warming ovens at all times.
- C. Make all finish welds 3/16" minimum.
- D. Make all butt welds full penetration, using back up or chip and back weld.

3.3 JOB CONDITIONS

Determine that all previous work is complete and ready for the erection of the structural steel. Promptly notify the owners representative of discrepancies and do not proceed in the questioned areas until fully resolved.

3.4 ERECTION

Erect all structural steel in accordance with the original design and the approved submittals, all pertinent codes and regulations, and the referenced standards.

Align structural steel straight, true, square and plumb, and within a tolerance of 1 in 500.

After erection is complete, touch up all shop priming coats damaged during transportation and erection, and prime all field welds using same primer paint approved for shop priming.

END OF SECTION

DIVISION 06

WOOD, PLASTICS, AND COMPOSITES

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SECTION 06 60 00 - FIBERGLASS FABRICATIONS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- 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. The Contractor shall furnish, fabricate (where necessary), and install all fiberglass reinforced plastic (FRP) items, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein, and in accordance with the requirements of the Contract Documents.
- B. Section Includes:
 - 1. Fiberglass Structural Shapes and Plate.
 - 2. Fiberglass Gating.
 - 3. Covered Molded Grating.
 - 4. Fiberglass Molded Stair Treads.
 - 5. Fiberglass Standard Railings.

1.3 REFERENCES

- A. ASTM D635 - Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
- B. ASTM D638 - Tensile Properties of Plastics.
- C. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics.
- D. ASTM D2344 - Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short Beam Method.
- E. ASTM D495 - High Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation.
- F. ASTM D696 - Coefficient of Linear Thermal Expansion for Plastics.

- G. ASTM E84 - Surface Burning Characteristics of Building Materials.
- H. The International Building Code.
- I. The Occupational Health and Safety Administration (OSHA) Code of Federal Regulations (CFR), Title 29, Section 1910.

1.4 SUBMITTALS

- A. Prepare, deliver, and process under provisions of Section 01 33 00 – Submittal Procedures.
- B. The Contractor shall furnish shop drawings of all fabricated gratings and accessories in accordance with the provisions of this Section. The Contractor shall verify all existing conditions.
- C. The Contractor shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details.
- D. The Contractor shall submit the manufacturer's published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables, and design calculations for all systems, sealed by a professional engineer licensed in the state of Alaska.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.
- B. All materials and equipment necessary for the fabrication and installation of structural shapes and plate, standard railings, ladders and cages, molded treads and appurtenances shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Engineer, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.
- C. Identify and match-mark all materials, items and fabrications for installation and field assembly.

1.6 QUALITY ASSURANCE

- A. The Installing Contractor shall assure that all field dimensions are taken accurately and communicated properly to the fiberglass Fabricator, that other trades will not affect a proper installation of the fiberglass, and that all materials manufacturer's instruction and recommendations are followed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fibergrate Composite Structures, Inc.: www.fibergrate.com.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 GENERAL

- A. Materials used in the manufacture of the fiberglass products shall be raw materials in conformance with the Specification.
- B. Use FM Approved Class 1 materials for all new construction and retrofit applications.
 - 1. Use all products within the limits of their FM Approval.
 - 2. FM Approved materials are required to have the Approval mark on the packaging or the material itself. Materials without proper labeling are not FM Approved; do not treat them as such.
 - 3. For further guidelines, refer to FM Global Property Loss Prevention Data Sheet 1-57, Plastics in Construction.
- C. All materials shall be of the kind and quality specified.
- D. All fiberglass products shall be manufactured using vinyl ester resin with flame retardant and ultraviolet (UV) inhibitor additives. A synthetic surface veil shall be the outermost layer covering the exterior surface. The flame retardant fiberglass shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E-84.
- E. After fabrication, all cut ends, holes and abrasions of FIBERGLASS shapes shall be sealed with a compatible resin coating.
- F. Fiberglass products exposed to weather shall contain an ultraviolet inhibitor. Should additional ultraviolet protection be required, a one mil minimum UV coating can be applied.

- G. All exposed surfaces shall be smooth and true to form.
- H. All mechanical grating clips shall be manufactured of Type 316SS stainless steel.

2.3 STRUCTURAL SHAPES AND PLATE

- A. All structural shapes are to be manufactured by the pultrusion process with a glass content minimum of 45%, maximum of 55% by weight. The structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.
- B. Material
 - 1. Structural shapes and plate shall be pultruded from vinyl ester resin with fire retardant additives to meet a flame spread rating of less than 25 per ASTM E-84 and meet the self-extinguishing requirements of ASTM D-635.
 - 2. All structural shapes shall be fabricated per the Shop Drawings with good workmanship, closely fitted joints, and finished true to lines and in accurate position to permit the installation and proper joining of parts in the field.
 - 3. All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.
 - 4. All pultruded structural shapes shall be further protected from ultraviolet (UV) attack with 1) integral UV inhibitors in the resin and 2) a synthetic surfacing veil to produce a resin rich surface.

2.4 GRATING FABRICATION

- A. Manufacture: Grating shall be of a one piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane. Grating shall have a square mesh pattern providing bidirectional strength. Grating shall be reinforced with continuous rovings of equal number of layers in each direction. The top layer of reinforcement shall be no more than 1/8" below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements of the CONTRACT.

- B. Where covered grating is required, the grating cover plate shall be attached to the completed panel of grating by chemical means to ensure integral action of the panel and plate. The panel and grating shall be uniformly clamped together to ensure that all contact surface remain in contact throughout the curing process.
- C. Non-slip surface: Grating shall be manufactured with an integrally applied grit to the top surface of each bar providing maximum slip resistance. Covered grating shall have a gritted surface.
- D. Measurements: Grating supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work. When field dimensions are not required, Contractor shall determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.
- E. Layout: Each grating section shall be readily removable, except where indicated on Drawings. Manufacturer to provide openings and holes where located on the contract drawings. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.
- F. Sealing: All shop fabricated grating cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated grating cuts shall be coated similarly by the Contractor in accordance with the manufacturer's instructions.
- G. Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced at maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer.
- H. Covered grating load/deflection requirements at the required span shall be less than manufacturers published maximum recommended loads. Grating shall be designed for a uniform load of 100 psf or concentrated load of 300 lb. Deflection is not to exceed 0.375" or $L/D = 120$, whichever is less.

2.5 STANDARD RAILINGS

- A. Material:
 - 1. The rails and posts shall be 2" x 2" x .156" square tube manufactured by the pultrusion process. If pickets are required, they are to be a minimum of 1" square tube.
 - 2. All post to rail connection to be fully bonded with an epoxy adhesive and shall have a 1-1/2" square solid internal connection plug for added strength and durability. All connections to have a smooth transition between post and rail.

3. Fiberglass handrail to standard 2-rail design, unless noted otherwise.
4. The pultruded parts shall be made with a fire retardant resin that meets the ASTM E-84 test for a flame spread rating of 25 or less.
5. The resin matrix shall be vinyl ester and shall contain a UV inhibitor.
6. The color shall be chosen from manufacturer's full line of colors.

B. Fabrication of standard railing:

1. The fiberglass standard railing system shall be fabricated into finished sections by fabricating and joining together the pultruded square tube using molded or pultruded components; epoxy bonded and connected as shown in the fabrication details. Railing sections shall be fabricated to the size shown on the approved fabrication drawings and shall be piece marked with a waterproof tag.

C. For side mount:

1. Post shall be constructed with a square pultruded bottom plug. Length shall be sufficient to extend a minimum of 1" beyond the uppermost bolt hole to prevent crushing of post tubing. Bolt holes shall provide clearance of 1/16" for 1/2" diameter bolts/studs. On square tubes, holes shall be on longitudinal center line of post, 1" from bottom of post (minimum) and not less than 3" apart on center. Posts shall be fastened with stainless steel anchor bolts or studs, 1/2" diameter extending no less than 2-1/4" into the concrete, or into minimum thickness of 1/4" structural steel or pultruded fiberglass.
2. Post locations shall be no greater than 18", nor less than 9" from horizontal or vertical change in handrail direction. For square tubes, post centers shall be no greater than 72" apart on any straight run or rail, or 48" apart on any inclined rail section.

D. Other attachment methods:

1. Base mount, embedded and removable are also types of mounting procedures for railing pending design and approval by the Engineer.

2.6 MOLDED STAIR TREADS

A. Design:

1. The grating shall be one piece construction with the tops of the bearing bars and cross bars in the same plane.
2. The mesh pattern and thickness shall be as required to resist 100 psf uniform loading over the span indicated with less than 1/4-inch of deflection.

3. The resin used in the manufacture of the grating shall be vinyl ester.
4. Grating shall be fire retardant with a flame spread rating of 25 or less when tested in accordance with ASTM E-84.
5. For slip resistance, the top of each bar shall have quartz grit applied.
6. Stair treads shall have safety yellow integral bull nosings.

B. Products:

1. The stair tread shall come complete with anti-slip nosing.
2. Hold down clamps shall be:
 - a. Type M clips for attaching grating to supports.
3. All cut and machined edges, holes and abrasions shall be sealed with a compatible resin.
4. All panels shall be fabricated to the sizes shown on the approved shop drawing.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from infiltration of water and debris.

3.2 INSTALLATION, GENERAL:

- A. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous fiberglass fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through- bolts, lag bolts and other connectors needed.
- B. Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of miscellaneous fiberglass fabrications. Set fiberglass fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; measured from established lines and levels.

- C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.
- D. If required, all field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer.
- E. Install items specified as indicated and in accordance with manufacturer's instructions.

3.3 INSTALLATION OF HANDRAIL SECTIONS

- A. The fabricated railing sections shall be supplied complete with fittings by the FIBERGLASS manufacturer. The components used to join fabricated sections together may be shipped loose, to be epoxied and riveted, if required, together, if required in the field by the Contractor.
- B. The fabricated handrail sections shall be installed as shown on the approved shop drawings. The handrail sections shall be accurately located, erected plumb and level. The sections shall be fastened to the structure as shown on the approved shop drawings.

END OF SECTION 06 60 00

DIVISION 07

THERMAL AND MOISTURE PROTECTION

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SECTION 07 42 00 - METAL WINDOW PANELS

PART 1 - GENERAL

1.1 SCOPE

- A. The Panels required are as manufactured by Mapes Architectural Panels, LLC, Lincoln, NE. Panels consist of metal skins laminated to stabilizer substrates with an insulating core material. Panels are designed to be glazed into a window system or curtain wall system.
- B. Related Work
 - 1. Section 07 62 00 - Sheet Metal Flashing and Trim

1.2 QUALITY ASSURANCE

- A. Panel manufacturer shall have a minimum of 25 years' experience.
- B. Field measurements shall be taken prior to completion of manufacturing and cutting.
- C. Maximum deviation from vertical and horizontal alignment of installed panels is 1/8" (3mm) in 20' (6m) non-commutative.

1.3 REFERENCES

- A. American Society of Testing Materials (ASTM)
 - 1. E330-84: Structural Performance of Exterior Windows, Curtain Walls and Doors under the influence of wind loads.

1.4 SUBSTITUTIONS

- A. The materials and products specified in this section establish a minimum standard of required function, design, appearance quality and warranty to be met by any proposed substitution.

1.5 SUBMITTALS

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

1. Panel makeup - 2 samples - 10"x10"
2. Two samples of each color and finish texture - 3"x5"
- C. Submission Drawings: Indicate thickness, dimension and components of parts. Detail glazing methods, framing and tolerances to accommodate thermal movement.
- D. Affidavit certifying materials meet all requirements as specified.
- E. 2 copies of manufacturer's standard literature for specified material.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protect finish and edge in accordance with panel manufacturer's recommendations.
- B. Store materials in accordance with panel manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 PANELS - LAMINATED

- A. Laminated metal faced Mapes-R panels as manufactured by Mapes Industries, Inc.
- B. Acceptable alternatives: Panels having similar composite construction and finish providing manufacturer has a minimum of 25 years panel laminating experience and comparable published warranties.

2.2 FINISH

- A. Exterior: Standard Kynar on Steel.
 1. Texture: Smooth.
 2. Color 1: To match existing exterior panel skin.
- B. Interior: Standard Kynar on Steel.
 1. Texture: Embossed.
 2. Color 2: To match existing interior panel skin.

2.3 PANEL FABRICATION

- A. Exterior Substrate: Tempered Hardboard.
- B. Core: Isocyanurate.
- C. Interior Substrate: Tempered Hardboard.
- D. Tolerances - .8% of panels dimension length and width - (+/-) 1/16" thickness.
- E. Panel Thickness - 1.25"
- F. R-Value - 8.28
- G. U-Value - 0.12

2.4 ACCESSORIES

- A. Recommended for use as an infill panel component in window and curtain wall systems. Related material to complete installation as recommended by the manufacturer.
- B. Seals against moisture intrusion as recommended by the manufacturer. Polyurethane and silicone based sealant with a 20-year life are recommended.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Panel surfaces shall be free from defects prior to installation.

3.2 EXECUTION

- A. Erect panels plumb, level and true.
- B. Glaze panels securely and in accordance with approved shop drawings and manufacturer's instructions to allow for necessary thermal movement and structural support.
- C. Do not install panels that are observed to be defective including warped, bowed, dented, scratched and delaminating components.
- D. Weatherseal all joints as required using methods and materials as previously specified.

- E. Separate dissimilar metals using gasketed fasteners and blocking to eliminate the possibility of electrolytic reaction.

3.3 ADJUSTING AND CLEANING

- A. Remove masking film as soon as possible after installation. Masking intentionally left in place after panel installation will be the responsibility of the Contractor.
- B. Weep holes and drainage channels must be unobstructed and free from dirt and sealant.

END OF SECTION 07 42 00

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Sealants for joints within sheet metal fabrications.

1.2 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- E. CDA A4050 - Copper in Architecture - Handbook.
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual.

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS

- A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch thick base metal, shop pre-coated with PVDF coating.
 - 1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: To match existing building color schemes.

2.2 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.3 EXTERIOR PENETRATION FLASHING PANELS

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.4 ACCESSORIES

- A. Fasteners: Stainless steel with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- E. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.

3.3 INSTALLATION

- A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.

END OF SECTION 07 62 00

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

1.2 REFERENCE STANDARDS

- A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- B. ASTM C1193 - Standard Guide for Use of Joint Sealants.

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
1. Bostik Inc.: www.bostik-us.com/#sle.
 2. Dow: www.dow.com/#sle.
 3. Sika Corporation: www.usa.sika.com/#sle.
 4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

2.2 JOINT SEALANT APPLICATIONS

- A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on Drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. Joints between different exposed materials.
 - c. Other joints indicated below.
 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. Other joints indicated below.
 3. Do not seal the following types of joints.
 - a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.

- c. Joints where installation of sealant is specified in another section.
- B. Exterior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
- C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

2.3 NONSAG JOINT SEALANTS

- A. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Color: Match adjacent finished surfaces.

2.4 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Install bond breaker backing tape where backer rod cannot be used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION 07 92 00

DIVISION 08

DOORS AND WINDOWS

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SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Thermally insulated hollow metal doors with frames.
- B. Accessories, including glazing.

1.2 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 09 90 00 – Painting And Coating.

1.3 REFERENCE STANDARDS

- A. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors.
- B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100).
- C. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.
- F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames.
- I. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames.

- J. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames.
- K. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames.
- L. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames.
- M. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Maintain at project site copies of reference standards relating to installation of products specified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Hollow Metal Doors and Frames:

1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Fleming Door Products, an Assa Abloy Group company: www.assaabloydss.com/#sle.
4. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
5. Steelcraft, an Allegion brand: www.allegion.com/#sle.
6. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
3. Door Edge Profile: Manufacturers standard for application indicated.
4. Typical Door Face Sheets: Flush.
5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on Drawings. Style: Manufacturer's standard.
6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
 - 2. Door Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 - 3. Door Thermal Resistance: R-Value of 8.7, minimum, for installed thickness of polyurethane.
 - 4. Door Thickness: 1-3/4 inches, nominal.
 - 5. Weatherstripping: Refer to Section 08 71 00.

2.4 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Exterior Door Frames: Face welded type.

1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
3. Frame Finish: Factory primed and field finished.
4. Weatherstripping: Separate, see Section 08 71 00.

2.5 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.6 ACCESSORIES

- A. Door Window Frames: Door window frames with glazing securely fastened within door opening.
1. Size: As indicated on Drawings.
 2. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
 3. Metal Finish: Gray polyester powder coating.
 4. Glazing: 1 inch thick, clear, insulated, safety glass, in compliance with requirements of authorities having jurisdiction.
- B. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Install door hardware as specified in Section 08 71 00.

3.3 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.4 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.5 SCHEDULE

- A. Refer to Door and Frame Schedule on the Drawings.

END OF SECTION 08 11 13

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hardware for hollow metal doors.
- B. Thresholds.
- C. Weatherstripping and gasketing.

1.2 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.

1.3 REFERENCE STANDARDS

- A. BHMA A156.1 - Standard for Butts and Hinges.
- B. BHMA A156.2 - Bored and Preassembled Locks and Latches.
- C. BHMA A156.4 - Door Controls - Closers.
- D. BHMA A156.5 - Cylinders and Input Devices for Locks.
- E. BHMA A156.7 - Template Hinge Dimensions.
- F. BHMA A156.18 - Materials and Finishes.
- G. BHMA A156.21 - Thresholds.
- H. BHMA A156.22 - Standard for Gasketing.
- I. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames.
- J. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
 - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
 - 2. Provide complete description for each door listed.
 - 3. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
 - 4. Include account of abbreviations and symbols used in schedule.
- D. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.7 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
 - 1. Closers: 20 years, minimum.

2. Locksets and Cylinders: Three years, minimum.
3. Other Hardware: Two years, minimum.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Provide door hardware products that comply with the following requirements:
 1. Applicable provisions of federal, state, and local codes.
 2. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
- D. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.
- E. Fasteners:
 1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
 - a. Aluminum fasteners are not permitted.
 - b. Provide Phillips flat-head screws with heads finished to match door surface hardware, unless otherwise indicated.

2.2 HINGES

- A. Manufacturers:
 1. McKinney; an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Hager Companies: www.hagerco.com/#sle.

B. Hinges: Comply with BHMA A156.1, Grade 1.

1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
 - a. Provide hinge width required to clear surrounding trim.
2. Provide hinges on every swinging door.
3. Provide five-knuckle full mortise butt hinges, unless otherwise indicated.
4. Provide non-removable pins on exterior outswinging doors.
5. Provide following quantity of butt hinges for each door:
 - a. Doors from 60 inches High up to 90 inches High: Three hinges.

2.3 LOCK CYLINDERS

A. Manufacturers (Contractor to verify/coordinate with Owner):

1. Best, dormakaba Group: www.bestaccess.com/#sle.
2. Schlage, an Allegion brand: www.allegion.com/us.

B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.

1. Provide small format interchangeable core (SFIC) type cylinders, Grade 1, with seven-pin core in compliance with BHMA A156.5 at locations indicated.
 - a. Provide seven-pin core keyed to existing building keying system. Coordinate with Owner for core delivery.
2. Provide cylinders from same manufacturer as locking device.
3. Provide cams and/or tailpieces as required for locking devices.

2.4 CYLINDRICAL LOCKS

A. Manufacturers:

1. Best, dormakaba Group: www.bestaccess.com/#sle.
2. Schlage, an Allegion brand: www.allegion.com/us/#sle.

B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.

1. Bored Hole: 2-1/8 inch diameter.
2. Latchbolt Throw: 1/2 inch, minimum.
3. Backset: 2-3/4 inch unless otherwise indicated.
4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 - a. Finish: To match lock or latch.

2.5 CLOSERS

A. Manufacturers; Surface Mounted:

1. LCN, an Allegion brand: www.allegion.com/us/#sle.

B. Closers: Comply with BHMA A156.4, Grade 1.

1. Type: Surface mounted to door.
2. Provide door closer on each exterior door.

2.6 THRESHOLDS

A. Manufacturers:

1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.

B. Thresholds: Comply with BHMA A156.21.

1. Provide threshold at each exterior door, unless otherwise indicated.
2. Type: Flat surface.
3. Material: Aluminum.
4. Threshold Surface: Thermally broken.
5. Field cut threshold to profile of frame and width of door sill for tight fit.
6. Provide non-corroding fasteners at exterior locations.

2.7 WEATHERSTRIPPING AND GASKETING

- A. Manufacturers:
 - 1. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
- B. Weatherstripping and Gasketing: Comply with BHMA A156.22.
 - 1. Head and Jamb Type: Adjustable.
 - 2. Door Sweep Type: Encased in retainer.
 - 3. Material: Aluminum, with brush weatherstripping.

2.8 FINISHES

- A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
 - 1. Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.2 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item.
 - 1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
- D. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.3 ADJUSTING

- A. Adjust hardware for smooth operation.
- B. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.4 CLEANING

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.5 PROTECTION

- A. Protect finished Work under provisions of Section 01 73 00 - Execution and Section 01 77 00 - Closeout Procedures.
- B. Do not permit adjacent work to damage hardware or finish.

3.6 SCHEDULE

- A. HW-1 (Door 1)

Hinges	McKinney	T4A3386-US32D
Lockset	Best	9K-3-7-AB-15-D-S3-626
Closer	LCN	4110
Overhead Stop	Sargent	1710S-US32D
Weatherstrip Brush	Pemko	45061CNC
Perimeter Gasket	Pemko	S88BL
Door Bottom	Pemko	216PWPK
Threshold	Pemko	253x4AFG

END OF SECTION 08 71 00

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DIVISION 09

FINISHES

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SECTION 09 90 00 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints and other coatings.
- C. Scope: Finish all interior and exterior new surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Exposed surfaces of steel lintels and ledge angles.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Existing items unless specifically indicated.
 - 5. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 6. Floors, unless specifically so indicated.
 - 7. Glass.
 - 8. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; current edition.

- C. SSPC (PM1) - Good Painting Practice: SSPC Painting Manual, Vol. 1; Society for Protective Coatings; Fourth Edition.

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
- C. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures.
- E. Maintenance Data: Submit data including repair of painted and coated surfaces.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90° F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45° F for interiors; 50° F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 feet candles measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer, no exceptions.
- B. Paints:
 - 1. ICI Paints: www.icipaintsinna.com.
 - 2. Benjamin Moore & Co: www.benjaminmoore.com.
 - 3. PPG Paints: www.ppgpaints.com.
 - 4. Sherwin-Williams Company: www.sherwin-williams.com.
- C. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Supply each coating material in quantity required to complete entire project's work from a single production run.
 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: As follows, unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Colors: To match existing color schemes.

2.3 PAINT SYSTEMS - EXTERIOR

- A. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
1. One coat of alkyd primer.
 2. Semi-gloss: Two coats of alkyd enamel.
- B. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
 2. Semi-gloss: Two coats of alkyd enamel.
- C. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
1. One coat galvanize primer.
 2. Semi-gloss: Two coats of alkyd enamel.

2.4 PAINT SYSTEMS - INTERIOR

A. Paint MI-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:

1. One coat of alkyd primer.
2. Semi-gloss: Two coats of alkyd enamel.

B. Paint MI-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:

1. Touch-up with alkyd primer.
2. Semi-gloss: Two coats of alkyd enamel.

C. Paint MgI-OP-3A - Galvanized Metals, Alkyd, 3 Coat:

1. One coat galvanize primer.
2. Semi-gloss: Two coats of alkyd enamel.

2.5 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin application of coatings until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing coatings that exhibit surface defects.
- D. When painting new items adjacent to existing items, remove or repair existing coatings a minimum of 12 inches in order to blend new and existing paint systems.
- E. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- F. Seal surfaces that might cause bleed through or staining of topcoat.
- G. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- I. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- J. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- K. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's instructions.
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance.
- F. Where new paint system abuts existing paint system, blend new paint a minimum of 12 inches onto existing.
- G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

END OF SECTION 09 90 00

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SECTION 09 90 10
PAINTING AND COATINGS FOR PROCESS EQUIPMENT

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Furnish and install surface preparation and coatings application for process related surfaces as specified.
- B. Furnish equipment specified in these Documents to receive Manufacturer's factory-finished coating(s) per this specification.
 - 1. Scope: Finish new and existing interior and exterior surfaces exposed to view, unless fully factory-finished where indicated.
 - a. Exposed metal piping/insulation.
 - 2. Do Not Paint or Finish the Following Items:
 - a. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - b. Items indicated to receive other finishes.
 - c. Items indicated to remain unfinished.
 - d. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - e. Stainless steel, anodized aluminum, bronze, and lead items.
 - f. Concealed pipes, ducts, and conduits.

1.2 RELATED SECTIONS

- A. 01 10 00 – Summary
- B. 01 33 00 – Submittal Procedures
- C. 01 60 00 – Product Requirements
- D. 40 05 01 – Process Piping
- E. 40 05 50 – Process Valves and Operators

1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. Society for Protective Coatings (SSPC) Standards.
- C. American Water Works Association (AWWA). Standard C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

1.4 DEFINITIONS

- A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils, or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness.
5. MDFTPC: Minimum Dry Film Thickness Per Coat.
6. Mil: Thousandth of an inch.
7. Military Specification-Paint.
8. PSDS: Paint System Data Sheet.
9. SFPG: Square Feet Per Gallon.
10. SFPGPC: Square Feet Per Gallon Per Coat.
11. SP: Surface Preparation.

1.5 SUBMITTALS

- A. Prepare, deliver and process submittals under provisions of Section 01 33 00, SUBMITTAL PROCEDURES.
- B. Requests for proposed substitute or “or-equal” systems/products will be considered in accordance with the provisions of Section 01 60 00, PRODUCT REQUIREMENTS.
- C. Complete list of all deviations from the Drawings and Specifications.
- D. Data: Submit required information for each paint system on system-by-system basis.
 1. Paint System Data Sheet (PSDS is appended to this section),
 2. Manufacturer’s Technical Data/Product Sheets, including VOC content,
 3. Two color wheels of full range of manufacturer's standard colors (where applicable). Electronic file submissions or locally printed documents are not acceptable in satisfying this requirement.
 4. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
 5. Manufacturer and applicator qualifications.
- E. Quality Control Submittals:
 1. Manufacturer’s written instructions and special details for applying each type of paint.
 2. Applicator's Experience: List of references substantiating experience.
 3. Field Testing: Inspection and test reports.
 4. Coating Applicator’s Certificate of Proper Installation.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum ten years’ experience.

- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum ten years' documented experience in application of specified products.
- C. Regulatory Requirements:
 - 1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
 - 2. Perform surface preparation and painting in accordance with recommendations of the following:
 - a. Paint manufacturer's instructions.
 - b. SSPC-PA Guide No. 3, Guide to Safety in Paint Applications.
 - c. Federal, state, and local agencies having jurisdiction.

1.7 PREINSTALLATION MEETING

- A. Prior to starting work on site, conduct a pre-installation meeting. As a minimum, discuss the work to be performed, the sequence of activities, coordination of work with other trades and between adjacent plant tanks, environmental controls, and testing and reporting procedures.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in unopened containers labeled with designated name, date of manufacture, color, and manufacturer; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Store products in a protected area, well ventilated, and heated or cooled to maintain temperatures within the range recommended by paint manufacturer.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Contractor shall employ best practices to control dust, fumes, and other airborne byproducts of the work using appropriate environmental controls. This may include tenting, ventilation, and other measures necessary to safeguard the Owner's staff and adjacent equipment and processes.
- B. Do not apply paints and coatings in temperatures outside of manufacturer's recommended maximum or minimum allowable, or in dust or smoke-laden atmosphere, damp or humid weather.
- C. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air. Further, the surface temperature must be at least 5 degrees F above the dew point at all times during and between final blasting and coating operations.
- D. The applicator shall maintain the proper environmental conditions for the application of the specified coatings.
- A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide all paints and coatings products used in any individual system from the same manufacturer; no exceptions.
- B. Protective Coatings:
 - 1. Tenemec Company, Inc.
 - 2. Devoe® High Performance Coatings
 - 3. Sherwin Williams
 - 4. Carboline
 - 5. Tennant Company
 - 6. Others as approved.

2.2 PROTECTIVE COATINGS

- A. Material Quality: Manufacturer's highest quality products and suitable for intended service.
- B. Materials Including Primer and Finish Coats: Produced by same manufacturer.
- C. Thinners, Cleaners, Driers, and Other Additives: As recommended by manufacturer of the particular coating.
- D. See APPLICATION SCHEDULE this Specification, paragraph 2.3.
- E. Mixing Multiple-Component Coatings:
 - 1. Prepare using the contents of the container for each component as packaged by paint manufacturer.
 - 2. No partial batches will be permitted.
 - 3. Do not use multiple-component coatings that have been mixed beyond their pot life.
 - 4. Furnish small quantity kits for touchup painting and for painting other small areas.
 - 5. Mix only components specified and furnished by paint manufacturer.
 - 6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.
 - 7. Keep material in sealed container when not in use.
 - 8. Colors:

- a. Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at the site.
- b. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required numbers of coats have been applied.

F. Protective Coatings Systems:

1. System No. 1 – Concrete:

Surface Prep.	Paint Material	Min. Coats, Cover
Detergent Wash to clear oil and grease, Commercial Blast, (SSPC-SP6)	Self-Priming, Polyamide Epoxy, Example Product: Tnemec Series 48	2 coats, 5 MDFT per coat
See Application Schedule this Section for location.		

2. System No. 2 Ductile Iron Pipe:

Surface Prep.	Coating	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10) DIP: NAPF-500-03-04.	Polyamide Epoxy Primer	1 coat, 3 MDFT min.
Detergent Wash, Fresh Water Rinse, brush blast if primer is aged, and in Accordance with the Manufacturer's Directions (as required)	Polyamide Epoxy	2 coat, 4 MDFT min. per coat
See Application Schedule this Section for location.		

2.3 PROTECTIVE COATINGS SYSTEMS - APPLICATION SCHEDULE:

- A. Unless otherwise shown or specified, coat surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from OWNER/ENGINEER before starting work.
- B. System No. 1 Concrete. Use on the following items or areas:
 1. All new concrete and grout installed by the Contractor, including but not limited to:
 - a. New or Modified Housekeeping Pads
 - b. New Concrete Supports for Screw Press Equipment

- c. New Curb & New Surfaces Under Screw Press Equipment
- 2. Existing concrete exposed by removal of existing housekeeping pads or other concrete features, including but not limited to:
 - a. Removed housekeeping pads underneath existing polymer tanks
- C. System No. 2 Ductile Iron Pipe. Use on items in the following areas:
 - 1. All newly installed ductile iron pipe, valves, and appurtenances

PART 3 EXECUTION

3.1 PROTECTIVE COATINGS

- A. Examination
 - 1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of coatings manufacturer whose product is to be applied. The more stringent requirements shall apply.
 - 2. Provide minimum 7 days advance notice to start of shop or field surface preparation work and coating application work.
- B. Preparation
 - 1. Protection of Items not to be coated: Remove, mask, or otherwise protect building features, flooring, equipment, piping, and appurtenances; hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be coated.
 - 2. Concrete Surfaces: ASTM D4259 Standard Practice for Abrading Concrete
 - 3. Metal Surfaces: Where indicated, meet requirements of the following SSPC Specifications:
 - a. Solvent Cleaning: SP 1-82.
 - b. White Metal Blast Cleaning: SP 5-91.
 - c. Brush-Off Blast Cleaning: SP 7-91.
 - d. Near-White Metal Blast Cleaning: SP 10-91.
 - e. Employee latest iteration of these standards.
 - 4. Solvent Cleaning (as required):
 - a. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action.
 - b. Meets requirements of SSPC-SP 1-82.
 - 5. Grind smooth burrs, jagged edges, and surface defects.
 - 6. Existing Surfaces to be Painted:
 - a. Detergent wash and freshwater rinse.

- b. Perform blasting as required to restore damaged surfaces. Materials, equipment, procedures shall meet requirements of Steel Structures Painting Council.
- 7. Welds and Adjacent Areas:
 - a. Prepare such that there is:
 - 1) No undercutting or reverse ridges on weld bead.
 - 2) No weld spatter on or adjacent to weld or any other area to be painted.
 - 3) No sharp peaks or ridges along weld bead.
 - b. Grind or brush-machine embedded pieces of electrode or wire flush with adjacent surface of weld bead.
- 8. Preblast Cleaning Requirements:
 - a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
 - b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
 - c. Clean small isolated areas as above or solvent clean with suitable solvents and clean cloths.
- 9. Blast Cleaning Requirements:
 - a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
 - b. Select type and size of abrasive to produce a surface profile that meets coating manufacturer's recommendations for particular primer to be used.
 - c. Use only dry blast cleaning methods.
 - d. Do not reuse abrasive, except for designed recyclable systems.
 - e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
- 10. Cleaning Welds in the Interior of Welded Steel Piping
 - a. Meet System 1 Surface Prep Requirements
 - b. Deploy interior pipe cleaning equipment into individual welded pipeline assemblies using disassembled mechanical pipeline joint locations as entry access locations.
 - c. Interior pipeline cleaning equipment to include:
 - 1) Truck or tractor crawler mounted equipment that can be remotely controlled as to location and activity
 - 2) Application/deployment of blast and/or abrasive cleaning procedures
 - 3) Vacuum removal of cleaning debris

- 4) Video inspection capability of cleaned interior pipe surfaces at welds
- 5) Application of detergent wash water and rinse water prior to application of final topcoat coating system.
- 6) Removal of waste detergent wash water/rinse water from cleaned undercoating system.
- 7) Protection of factory applied coating systems during weld cleaning efforts

11. Post-Blast Cleaning and Other Cleaning Requirements:

- a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
- b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

C. Application

1. General:

- a. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating for any purpose until completion of curing cycle.
- b. Apply coatings in accordance with these Specifications and the paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
- c. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
- d. Keep paint materials sealed when not in use.
- e. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required number of coats have been applied.

2. Stripe Coating:

- a. Stripe coat all field welds, edges, angles, fasteners, and other irregular surfaces.
- b. Stripe coat shall consist of one coat, brush applied, to the coating thickness specified.
- c. Apply stripe coat between intermediate and final coats.

3. Film Thickness:

- a. Number of Coats: Minimum required without regard to coating thickness. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.

- b. Maximum film build per coat shall not exceed coating manufacturer's recommendations.
 - c. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
 - 1) Perform with properly calibrated instruments.
 - 2) Recoat and repair as necessary for compliance with the Specifications.
 - 3) All coats are subject to inspection by Engineer and coating manufacturer's representative.
 - 4) Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thickness is likely to be present, and ensure proper millage in these areas.
 - d. Thickness Testing:
 - 1) Measure coating thickness specified in mils with a magnetic type dry film thickness gauge.
 - 2) Test finish coat for holidays and discontinuities with an electrical holiday detector, low voltage, wet-sponge type.
 - 3) Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
- 4. Damaged Coatings, Pinholes, and Holidays:
 - a. Feather edges and repair in accordance with recommendations of paint manufacturer.
 - b. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.
- 5. Unsatisfactory Application:
 - a. If item has an improper finish color, or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage on all affected areas. Obtain specific surface preparation information from coating manufacturer.
 - b. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
 - c. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
 - d. Repair defects in accordance with written recommendations of coating manufacturer.
 - e. Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval and provide additional staging and lighting as requested.
- 6. Coating Welds in the Interior of Welded Steel Piping

- a. Meet System 1 Surface Coating System Requirements
- b. Deploy interior pipe coating system application machine into individual welded pipeline assemblies using disassembled mechanical pipeline joint locations as entry access locations.
- c. Interior pipeline coating system application equipment to include:
 - 1) Truck or tractor crawler mounted equipment that can be remotely controlled as to location and activity
 - 2) Center and axial location guided coatings spray application equipment
 - 3) Video inspection capability of applied coating system applied at welds
 - 4) Photo image documentation capability
 - 5) Coating dry film thickness measurement capability
- D. Field Quality Control
 - 1. Testing Gauges:
 - a. Provide a magnetic type dry film thickness gauge to test coating thickness specified in mils. Mikrotest as manufactured by ElektroPhysik USA Inc., Arlington Heights, IL (1-800-782-1506).
 - b. Provide an electrical holiday detector, low voltage, wet sponge type to test finish coat, except zinc primer, high-build elastomeric coatings, and galvanizing, for holidays and discontinuities as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
 - 2. Daily test reports shall include the following minimum information: ambient environmental conditions; environmental conditions within the enclosure; general locations that holiday and thickness tests are performed; specific locations of failed tests; record of remedial action taken on failed tests.

(See PSDS form attached)

END OF SECTION

PAINT SYSTEM DATA SHEET

Complete and attach manufacturer's Technical Data Sheet to this PSDS for each coating system.

Paint System Number (from Spec.):		
Paint System Title (from Spec.):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats, Coverage

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DIVISION 22

PLUMBING

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SECTION 22 45 00 – EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Eye / Face Washes.

1.2 RELATED WORK

- A. Section 22 05 00 - Common Work Results for Plumbing.
- B. Section 22 10 00 – Plumbing Piping.
- C. Section 22 30 00 – Plumbing Equipment.

1.3 REFERENCES

- A. ANSI Z358.1 – 2009 Emergency Eyewash and Shower Equipment.
- B. OSHA Act 1910-151.C.

1.4 SUBMITTAL

- A. Submit under provisions of Division 01.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough in dimensions, utility sizes, capacities, materials, trim, and finishes.
- C. Manufacturer's installation instructions and performance limitations.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01.
- B. Maintenance Data: include fixture trim exploded view and replacement parts lists.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01.
- B. Accept fixtures on site in factory packaging. Inspect for damage.

- C. Protect installed fixtures and equipment from damage by securing areas and by leaving factory packaging in place to protect fixtures and equipment from damage.

1.7 FIELD MEASUREMENTS

- A. Verify all rough-in and finishing measurements in the field.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS: EMERGENCY SHOWER & EYE WASH EQUIPMENT

- A. Bradley.
- B. Guardian.
- C. Haws.
- D. Speakman.
- E. Substitutions: Under provisions of Division 01.

2.2 FREEZE RESISTANT UNITS

- A. Eye Wash Station
 - 1. Wall mounted emergency portable gravity operated eye wash shall include an FDA approved high-density green polyethylene 16 gallon tank, ABS plastic eye wash heads with .4 gpm flow rate over 15 minutes, yellow pull-down activation arm, integral handles on top and sides, and wide-fill threaded cap. Unit shall also include 1000 Watt, 120VAC submersible thermostatically controlled heater with a fitted insulating jacket which maintains a 70°F water temperature with as low as -30° F ambient temperatures, 9' power cord, label-mounted operation and maintenance instructions, and stainless steel wall bracket.
 - 2. Fixture: Haws 7500EB or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that mounting pads are prepared and ready for fixtures and equipment.
- B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

- A. Rough-in emergency fixtures and equipment piping connections in accordance with code requirements and manufacturers recommendations.

3.3 INSTALLATION

- A. Install emergency shower equipment in accordance with ANSI Z358.1-1998 and manufacturer's instructions. Set level and plumb. Secure in place to solid mounting surface.
- B. Protect fixtures and equipment during construction. At completion, thoroughly clean emergency showers and equipment.

END OF SECTION 22 45 00

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DIVISION 23

HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

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SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SCOPE

- A. All provisions of the Contract including the General and Supplementary Conditions and the General Requirements apply to this work.

1.2 WORK INCLUDED

- A. The work to be included in these and all other mechanical subsections shall consist of providing, installing, adjusting and setting into proper operation complete and workable systems for all items shown on the drawings, described in the specifications or reasonably implied. This shall include the planning and supervision to coordinate the work with other crafts and to maintain a proper time schedule for delivery of materials and installation of the work.
- B. Division 01 of the specifications is to be specifically included as well as all related drawings.

1.3 RELATED WORK

- A. Related Work Specified Elsewhere:
 - 1. Electrical Specifications: Division 26.
 - 2. Motors and Connections: Division 26.
 - 3. Starters and Disconnects: Division 26.
- B. Unless otherwise indicated on the electrical drawings or the electrical schedules, provide all mechanical equipment motors, motor starters, thermal overload switches, control relays, time clocks, thermostats, motor operated valves, float controls, damper motors, electric switches, electrical components, wiring and any other miscellaneous Division 23 controls. Disconnect switches are included in the electrical work, unless specifically called out on mechanical plans.
- C. Carefully coordinate all work with the electrical work shown and specified elsewhere.

1.4 REFERENCED CODES - LATEST ADOPTED EDITION

- A. NFPA 70 National Electrical Code (NEC).
- B. IMC International Mechanical Code.
- C. UPC Uniform Plumbing Code.
- D. IECC International Energy Conservation Code.

- E. IFC International Fire Code.
- F. IFGC International Fuel Gas Code.
- G. IBC International Building Code.

1.5 PROJECT RECORD DRAWINGS

- A. In addition to other requirements of Division 01, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all mechanical work which will become permanently concealed. Show routing of work in concealed blind spaces within the building. Show exact dimensions of buried piping off of columns or exterior walls.
- B. Maintain record documents at job site in a clean, dry and legible condition. Keep record documents available for inspection by the Project Manager.
- C. Show the location of all valves and their appropriate tag identification.
- D. At completion of project, deliver these drawings to the Owner and obtain a written receipt.

1.6 SUBMITTALS

- A. See General Conditions and the General Requirements in Division 01 regarding submittals.
- B. Submit by specification section complete and all at one time; partial submittals will not be considered. Submittals shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed under basic categories in order of the Specification Sections. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications.
- C. Catalog sheets shall be complete and the item or model to be used shall be clearly marked, and identified as to which item in the specifications or on the drawings is being submitted and with drawing fixture number where applicable.
- D. Only submit on items specifically required by each specification section. If a submittal has not been requested, it will not be reviewed.
- E. Submit product data for:
 - 1. Hangers and Supports for HVAC Equipment.
 - 2. Vibration and Seismic controls for HVAC Ductwork and Equipment.
 - 3. Identification for HVAC Ductwork and Equipment.
- F. Provide shop drawings with calculations for selection of seismic/wind restraints in accordance with IBC and ASCE 7, certified by a qualified professional engineer, licensed in the State of Alaska. Seismic calculations shall be based upon Seismic Category D. Seismic calculations for natural gas piping shall utilize and Component Importance Factor, IP, of 1.5. All other components shall utilize an IP of 1.0 for seismic calculations.

1.7 OPERATING AND MAINTENANCE MANUALS

- A. See General Conditions and the General Requirements in Division 01 regarding Operating and Maintenance Manuals.
- B. Submit maintenance manuals to the Engineer covering all equipment, devices, etc. installed by the Contractor.
- C. The operation and maintenance manuals shall be submitted by specification section complete and all at one time; partial operations and maintenance manual submittals will not be considered. The Operation and maintenance manuals shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed under basic categories. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications. The manual shall contain, but not limited to, the following types of information:
 - 1. Cover sheet with name, address, telephone number of Contractor, General Contractor and major equipment suppliers.
 - 2. Catalog cuts of all equipment, etc. installed (Marked to identify the specific items used).
 - 3. Manufacturer's maintenance and overhaul instruction booklets including exploded views.
 - 4. Identification numbers of all parts and nearest sources for obtaining parts and services.
 - 5. Reduced scale drawings of the control system and a verbal description of how these controls operate.
 - 6. A copy of the final test and balance report.
 - 7. A copy of valve schedule and reduced scale drawings showing valve locations.
 - 8. Written summary of instructions to Owner.
 - 9. All manufacturers' warranties and guarantees.
 - 10. Contractors Warranty Letter.
- D. A periodic maintenance form that includes all of the equipment shall be provided with the maintenance manual. The form shall list each piece of equipment and how often maintenance is required (daily, weekly, monthly, annually). Opposite each task shall be squares for check-off for a full year (initials) to verify that the tasks are being done.

1.8 HANDLING

- A. See General Conditions and the General Requirements in Division 01 regarding material handling.
- B. Deliver packaged materials to job site in unbroken packages with manufacturer's label, and store to facilitate inspection and installation sequence. All items must be labeled and identified as to make, size and quality.

1.9 SUBSTITUTIONS

- A. See General Conditions and the General Requirements in Division 01 for substitution request procedures.
- B. In accordance with the General Conditions and the General Requirements in Division 01, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment. The Architect/Engineer shall be the final authority regarding acceptability of substitutes.

1.10 DIMENSIONS

- A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings.
- B. Any differences, which may be found, shall be submitted to the Architect/Engineer for consideration before proceeding with the work.

1.11 MANUFACTURER'S DIRECTIONS

- A. All manufactured articles shall be applied, installed and handled as recommended by the manufacturer, unless specifically called out otherwise. Advise the Architect/Engineer of any such conflicts before installation.

1.12 PERMITS, FEES, ETC.

- A. The Contractor under each Division of these specifications shall arrange for a permit from the local authority. The Contractor shall pay for any inspection fees or other fees and charges required by ordinance, law, codes and these specifications.

1.13 TESTING

- A. The Contractor under each section shall perform the various tests as specified and required by the Architect, Engineer and as required by applicable code, the State and local authorities. The Contractor shall furnish all labor, fuel and materials necessary for making tests.

1.14 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.

- B. Where a material is described in detail, listed by catalogue number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.
- C. The use of the word "shall" conveys a mandatory condition to the contract.
- D. "This section" refers to the section in which the statement occurs.
- E. "The project" includes all work in progress during the construction period.
- F. In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.

1.15 SCHEDULE OF WORK

- A. The work under the various sections must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to meeting scheduled completion dates, and to avoid delaying any other trade. The Architect will set up completion dates. Each contractor shall cooperate in establishing these times and locations and shall process work so as to ensure the proper execution of it.

1.16 COOPERATION AND CLEANING UP

- A. The Contractor for the work under each section of the specifications shall coordinate the Contractors work with the work described in all other sections of the specifications to the end that, as a whole, the job shall be a finished one of its kind, and shall carry on the work in such a manner that none of the work under any section of these specifications shall be handicapped, hindered or delayed at any time.
- B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Architect, clear any designated areas or area of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

1.17 WARRANTY

- A. Unless a longer warranty is hereinafter called for, all work, materials and equipment items shall be warrantied for a period of one year after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the Architect/Engineer, shall be repaired and/or replaced to the complete satisfaction of the Architect/Engineer. Guarantee shall be in accordance with Division 01.

1.18 COMPLETION REQUIREMENTS

- A. In accordance with the General Conditions and the General Requirements in Division 01, Project Closeout; before acceptance and final payment, the Contractor shall furnish:

1. Accurate project record drawings, shown in red ink on prints, showing all changes from the original plans made during installation of the work.
2. Contractors One Year Warranty.
3. All Manufacturers' Guarantees.
4. Test and Balance Reports.
5. Operation and Maintenance Manuals.

1.19 INSPECTION OF SITE - REMODEL PROJECTS

- A. The accompanying plans do not indicate completely the existing plumbing and mechanical installations. The bidders for the work under these sections of the specifications shall inspect the existing installations and thoroughly acquaint themselves with conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work in the present building and underground serving to and from that structure. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

1.20 RELOCATION OF EXISTING INSTALLATIONS

- A. There are portions of the existing plumbing, mechanical and electrical systems, which shall remain in use to serve the finished building in conjunction with the indicated new installations. By actual examination at the site, each bidder shall determine those portions of the remaining present installations, which must be relocated to avoid interference with the installations of new work of the Contractors particular trade and that of all other trades. All such existing installations, which interfere with new installations, shall be relocated by the Contractor.

1.21 SALVAGE MATERIALS

- A. The Contractor shall remove existing equipment, duct, grilles and other items associated with the mechanical systems where no longer required for the project. Where such items are exposed to view or uncovered by any cutting or removal of general construction and has no continuing function (as determined by the Architect/Engineer), they shall be removed.
- B. All items or materials removed from the project shall be made available for the Owner's inspection. The Owner retains the option to claim any item or material. Contractor shall deliver any claimed item or material in good condition to the place designated by the Owner. All items not claimed become the property of the contractor and shall be removed from the site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All equipment shall be regularly cataloged items of the manufacturer and shall be supplied as a complete unit in accordance with the manufacturer's standard specifications along with any optional items required for proper installation unless otherwise noted. Maintain manufacturer's identification, model number, etc. on all equipment at all times.
- B. Where more than one of an item is to be provided, all of the items shall be identical manufacture, make, model, color, etc.

2.2 RESTRICTED MATERIALS

- A. No materials containing asbestos in any form shall be allowed.
- B. No solder or flux containing lead shall be used on this project.
- C. Where materials or equipment provided by this Contractor are found to contain restricted materials, such items shall be removed and replaced with non-restricted materials items. Entire cost of restricted materials removal and disposal and cost of installing new items shall be the responsibility of the Contractor for those restricted materials containing items installed by the Contractor.

2.3 ELECTRICAL MOTORS

- A. Motors: Furnish electric motors designed for the specific application and duty applied, and to deliver rated horsepower without exceeding temperature ratings when operated on power systems with a combined variation in voltage and frequency not more than + 10% of rated voltage. Motors for pumps and fans shall be selected to be non-overloading.
- B. Verify from the drawings and specifications the available electrical supply characteristics and furnish equipment that will perform satisfactorily under the conditions shown and specified.
- C. All motors for use with equipment with variable frequency drives shall be inverter ready motors. Verify compatibility and sizing of motor with variable frequency drive.
- D. Size motors for 1.15 service factor and not to exceed 40° C temperature rise above ambient.
- E. Fractional horsepower motors to have self-resetting thermal overload switch.
- F. Provide Premium Efficiency, motors for all three phase motors one horsepower and larger. Standard efficiency motors will not be acceptable.

2.4 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

- A. Plastic Nameplates: Laminated plastic with engraved letters.

- B. Plastic Tags: Laminated plastic with engraved letters, minimum 1-1/2 inches diameter.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.5 PIPE HANGERS AND SUPPORTS

- A. Acceptable Manufacturers:
 - 1. Anvil.
 - 2. PHD Manufacturing, Inc.
 - 3. Michigan Hanger Company.
 - 4. B-Line Systems, Inc.
- B. Natural Gas Piping:
 - 1. Conform to ANSI/MSS SP58.
 - 2. Hangers for Pipe Sizes ½ to 1-½ Inch: Malleable iron, adjustable swivel, split ring for steel pipe, copper swivel for copper pipe.
 - 3. Hangers for Hot Pipe Sizes 2 to 4 Inches and Cold Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Wall Support for Pipe Sizes to 3 Inches: Strut triangular bracket with pipe clamp and cushion insulator.
 - 5. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for hot pipe sizes 6 inches and over.
 - 6. Vertical Support: Steel riser clamp.
- C. Shield for Insulated Piping 1-½ Inches and Smaller: 18 gauge galvanized steel shield over insulation in 180° segments, minimum 12 inches long at pipe support.
- D. Shield for Insulated Piping 2 Inches and Larger: Hard block, calcium silicate insert, 180° segment, 12 inch minimum length, block thickness same as insulation thickness, flame resistant vapor barrier covering and 18 gauge galvanized shield.
- E. Shields for Vertical Copper Pipe Risers: Galvanized steel pipe.
- F. Design hangers to allow installation without disengagement of supported pipe.
- G. Copper Plating: All hanger elements in metal-to-metal contact with copper pipe, except hanger rings with factory-applied 1/16 inch minimum thick plastic or tape cushion strip over all contact surfaces.

- H. Strut Type Pipe Hanging System: Unistrut P-1000 series; framing members shall be No. 12 gage formed steel channels, 1-5/8 inch square, conforming to ASTM A 653 GR33, one side of channel shall have a continuous slot with inturned lips; framing nut with grooves and spring 1/2 inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A 307; fittings conforming to ASTM A 575; all parts enamel painted or electro-galvanized.
- I. Fixed Strut Rooftop Pipe Supports: Foam bottom, UV stabilized thermoplastic base, with hot dip galvanized strut support. Size as required for pipe. Minimum 6" Height, utilize adjustable height as required. Erico Caddy Pyramid ST or approved equal.
- J. Fixed Roller Rooftop Pipe Supports for Pipe Sizes to 6 Inches and smaller: Foam bottom, UV stabilized thermoplastic base, with polymeric rollers and hot dip galvanized retraining strap. Size as required for pipe. Minimum 6" Height, utilize adjustable height as required. Erico Caddy Pyramid RL or approved equal.

2.6 HANGER RODS

- A. Steel Hanger Rods: Threaded both ends, or continuous threaded.

2.7 FLASHING

- A. Metal Flashing: 26-gauge minimum galvanized steel.
- B. Metal Counter Flashing: 22 gauge minimum galvanized steel.
- C. Flexible Flashing: 47-mil thick sheet butyl, compatible with roofing.
- D. Caps: Steel, 22-gauge minimum; 16 gauge at fire resistant elements.

2.8 EQUIPMENT CURBS

- A. Fabricate curbs of wood or steel beam, unless specifically called out otherwise.

2.9 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
 - 5. Substitutions under provisions of Division 01.
- B. Product Description: Galvanized 12 gauge (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.

2.10 ACCEPTABLE MANUFACTURERS: VIBRATION ISOLATORS AND SEISMIC RESTRAINT

- A. Vibration isolators and Seismic Restraint shall be manufactured by:
1. Amber/Booth.
 2. Cooper Industries.
 3. International Seismic Application Technology.
 4. Kinetics Noise Control.
 5. Mason Industries.
 6. Vibro-Acoustics
 7. Substitutions: Items of same function and performance are acceptable in conformance with Division 01.

2.11 VIBRATION ISOLATORS (ROTATING EQUIPMENT EXCEPT FANS)

- A. Floor Mount: Closed spring mount with iso-stiff springs and limit stop for seismic restraint. Isolators are to be sized and selected by equipment manufacturer.
- B. Hangers: Closed spring hanger with acoustic isolator.
- C. Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.
- D. Color code spring mounts, spring selected to operate at no greater than 2/3 solid deflection and have ¼" ribbed neoprene pads.

2.12 FAN ISOLATION

- A. Provide spring type isolators for fans and heating and ventilation units.
- B. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or ¼ inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be not less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.
- C. Seismically restrained spring isolators shall be as described above, built into a ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of ¼ inch travel in all directions before contacting the resilient snubbing collars. Mountings shall be SSLFH as manufactured by Mason Industries.
- D. Cabinet unit heaters, panel fans, and other ventilation units mounted to solid ductwork or structure shall be internally factory isolated.

2.13 VENTILATING SYSTEMS FLEXIBLE CONNECTIONS

- A. Fabricate of neoprene coated flameproof fabric a minimum of 3" wide tightly crimped into metal edging strip and attach to ducting and equipment by screws or bolts at 6" intervals. DuroDyne Dynalon treated duct material, or equal. Durolon or equal for outdoor or high pressure applications.

2.14 LIMITS OF VIBRATION

- A. The factory is to statically and dynamically balance all rotating machinery, fans and pumps, etc. Do dynamic balancing at the operating speed of the motor.
- B. Select isolated equipment in accordance with the weight distribution, to produce uniform deflection on the vibration mounts. Deflection of vibration mounts shall be required to produce 95% vibration isolation efficiency, based on the equipment HP, rpm, location in regard to critical spaces and stiffness of the building supporting structural members, supporting the equipment.
- C. For fan-motor units in which the impeller is supported by the motor shaft, the motor and impeller shall be dynamically balanced as an integral unit.

2.15 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

- A. General:
 - 1. Seismic restraint designer shall coordinate all attachments with the structural engineer of record.
 - 2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
 - 3. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
 - 4. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in installation requirements.
 - 5. The total height of the structure (h) and the height of the system to be restrained within the structure (z) shall be determined in coordination with architectural plans and the General Contractor.
- B. Friction from gravity loads shall not be considered resistance to seismic forces.

2.16 SEISMIC BRACING COMPONENTS

- A. Steel strut shall be 1-5/8 wide in varying heights and mig-welded combinations as required to meet load capacities and designs indicated. A material heat code, part number, and manufacturer's name shall be stamped on all strut and fittings to maintain traceability to material test reports.
 - 1. Material for epoxy painted strut: ASTM A1011, SS, Grade 33.

2. Material for pre-galvanized strut: ASTM A653, SS, Gr. 33.
3. Material for Hot-Dip Galvanized strut: ASTM A1011, SS, Grade 33 and hot-dip galvanized after fabrication in accordance with ASTM A123.
4. Material for fittings and accessories: ASTM A907 Gr. 33, Structural Quality or ASTM A1011, SS, Gr.33.
5. Fittings and accessories: Products shall be of the same manufacturer as strut and designed for use with that product.

PART 3 - EXECUTION

3.1 DRAWINGS

- A. The drawings are partly diagrammatic, not necessarily showing all offsets or exact locations of piping and ducts, unless specifically dimensioned. The contractor shall provide all materials and labor necessary for a complete and operable system. Complete details of the building which affect the mechanical installation may not be shown. For additional details, see Architectural, Structural and Electrical Drawings. Coordinate work under this section with that of all related trades.

3.2 INSTALLATION

- A. All work shall comply with the latest adopted applicable codes and ordinances including, but not limited to, the IMC, UPC, IBC, NEC, NFPA, IECC, IFGC and IFC Standards; all local and state amendments to all codes and standards.
- B. Obtain and pay for all inspection fees, connection charges and permits as a part of the Contract.
- C. Compliance with codes and ordinances shall be at the Contractor's expense.
- D. Install in accordance with manufacturer's instructions.

3.3 MEASUREMENTS

- A. Verify all measurements on the job site.
- B. Locate all equipment on the centers of walls, openings, spaces, etc., unless specified otherwise.
- C. Check all piping, ducts, etc. to clear openings.
- D. Rough-in dimensions shall be per manufacturer's recommendations and in compliance with current ADA and ANSI 117.1 standards.

3.4 OPERATING INSTRUCTIONS

- A. Before the facility is turned over to the Owner, instruct the Owner or Owner's personnel in the operation, care and maintenance of all systems and equipment under the jurisdiction of the Mechanical Division. These instructions shall also be included in a written summary in the Operating Maintenance Manuals.
- B. The Operation and Maintenance Manuals shall be utilized for the basis of the instruction. Provide a minimum of four hours of on site instruction to the owner designated personnel.
- C. When required by individual specification sections provide additional training on HVAC systems and equipment as indicated in the respective specification section.
- D. Provide schedule for training activities for review prior to start of training.

3.5 SYSTEM ADJUSTING

- A. Each part of each system shall be adjusted and readjusted as necessary to ensure proper functioning of all controls, proper air distribution, elimination of drafts, noise and vibration.
- B. Balance air and water systems for volume quantities shown and as required to ensure even temperature and the elimination of drafts. Balancing shall be done by a qualified firm acceptable to the Engineer. Provide balancing log to the Engineer before substantial completion.

3.6 CUTTING, FITTING, REPAIRING, PATCHING AND FINISHING

- A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where it is necessary to disturb such work to permit installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.
- B. Avoid cutting, insofar as possible, by setting sleeves, frames, etc. and by requesting openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for ducts and piping.
- C. Cut all holes neatly and as small as possible to admit work. Include cutting where sleeves or openings have been omitted. Perform cutting in a manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.7 PAINTING

- A. Perform all of the following painting in accordance with provisions of Division 09 with colors as selected by the Architect. Provide the following items as a part of mechanical work:
 - 1. Factory applied prime and finish coats on mechanical equipment.
 - 2. Factory applied prime and finish coat on all air registers, grilles and diffusers, unless otherwise specified.
 - 3. Factory applied prime coat on access doors.

4. Pipe identification where specified.

- B. If factory finish on any equipment furnished is damaged in shipment or during construction, refinish to equal original factory finish.

3.8 IDENTIFICATION

- A. Tag all valves with heat resistant laminated plastic labels or brass tags engraved with readily legible letters. Securely fasten to the valve stem or bonnet with beaded chain. Provide a framed, typewritten directory under glass, and installed where directed. Provide complete record drawings that show all valves with their appropriate label. Seton 250-BL-G, or 2961.20-G, 2" round or equal.
- B. Label all equipment with heat resistant laminated plastic labels having engraved lettering ½" high. If items are not specifically listed on the schedules, consult the Engineer concerning designation to use. Seton engraved Seton-Ply nameplates or equal.
- C. Identify piping to indicate contents and flow direction of each pipe exposed to view by a labeled sleeve in letters readable from floor at least once in each room and at intervals of not more than 20' apart and on each side of partition penetrations. Coloring scheme in accordance with ANSI A13.1-1981, Seton Opti-Code or equal.

3.9 PIPE HANGERS AND SUPPORTS

- A. Support piping as follows:

Pipe Size	Max. Hanger Spacing	Hanger Diameter
½ to 1-¼ inch	6'-0"	3/8"
1-½ to 2 inch	10'-0"	3/8"
2-½ to 3 inch	10'-0"	½"
4 to 6 inch	10'-0"	5/8"

Notes:

^a See piping manufacturer installation instructions for additional requirements.

- B. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.
- C. Place a hanger within 12 inches of each horizontal elbow.
- D. Use hangers with 1-½ inch minimum vertical adjustment.
- E. Support vertical piping at every floor.
- F. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.

- H. Support all piping on flat roofs using rooftop pipe supports. Install per manufacturer's instructions. Install piping minimum 6" above roof surface.

3.10 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.11 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases of where shown on plans and where required by equipment manufacturer installation instructions.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.12 FLASHING

- A. Provide flexible flashing and metal counter-flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide curbs for mechanical roof installations 30 inches minimum high above roofing surface. Flexible sheet flash and counter-flash with sheet metal; seal watertight.

3.13 SCOPE OF VIBRATION ISOLATION WORK

- A. All vibrating equipment and the interconnecting pipe shall be isolated to eliminate the transmission of objectionable noise and vibration from the structure.
- B. HVAC equipment shall be carefully checked upon delivery for proper mechanical performance, which shall include proper noise and vibration operation.
- C. All installed rotating equipment with excessive noise and/or vibration, which cannot be corrected in place, shall be replaced at no cost to Owner.

3.14 GENERAL PROCEDURES – VIBRATION ISOLATION

- A. Select isolators in accordance with the manufacturer's recommendations and the equipment weight distribution to allow for proper static deflection of the isolators in relation to the span of the building structure supporting the equipment, considering the allowable deflection and weight of the structure.
- B. Install isolators so they can be easily removed for replacement.
- C. Mount all equipment absolutely level.
- D. Install all isolators per manufacturer's instructions.
- E. Install vibration isolators for mechanical motor driven equipment.
- F. Set steel bases for 1" clearance between housekeeping pad and base.
- G. All vibration isolated equipment shall be fitted with earthquake bracing and snubbers suitable for seismic control in accordance with the IBC.
- H. Piping vibration isolation flexible connections shall be installed at a 90° angle to equipment deflection direction unless otherwise noted.

3.15 SEISMIC RESTRAINT

- A. General:
 - 1. All equipment, piping and ductwork shall be restrained to resist seismic/wind forces per the applicable building code(s) as a minimum. Restraint attachments shall be made by bolts, welds or a positive fastening method. Friction shall not be considered. All attachments shall be proven capable of accepting the required wind load by calculations. Additional requirements specified herein are included specifically for this project.
 - 2. Install seismic and wind restraint devices per the manufacturer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.
 - 3. Attachment to structure for suspended equipment, pipe and duct: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
 - 4. Wall penetrations may be used as bracing locations provided the wall can provide adequate resistance without significant damage.
 - 5. Coordinate sizes and locations of cast-in-place inserts for post-tensioned slabs with seismic restraint manufacturer.
 - 6. Provide hanger rod stiffeners where indicated or as required to prevent buckling of rods due to seismic forces.

7. Where rigid restraints are used on equipment, ductwork or piping, support rods for the equipment, ductwork or piping at restraint locations must be supported by anchors rated for seismic use. Post-installed concrete anchors must be in accordance with ACI 355.2.
8. Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices and shall also be large enough to ensure adequate edge distance for restraint anchor bolts to avoid housekeeping pad breakout failure.

B. Equipment Restraints:

1. Seismically restrain equipment all equipment. Install fasteners, straps and brackets as required to secure the equipment.
2. Install seismic snubbers on HVAC equipment supported by floor-mounted, non-seismic vibration isolators. Locate snubbers as close as possible to vibration isolators and attach to equipment base and supporting structure as required.
3. Install neoprene grommet washers on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 1/8" (3.2 mm).
4. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Duct Systems:

1. Seismically restrain all ductwork listed below, using seismic cable restraints:
 - a. All ducts with cross-sectional area equal to or greater than 6 ft² (0.55 m²).
 - b. Any ductwork which if it were to fail would result in damage to a piece of equipment or building function that has a component importance factor of 1.5.
 - c. All ductwork weighing more than 17 lbs/ft (25 kg/m).
2. "12-inch rule", where duct can be exempted from seismic restraint based on the length of the support rods, is accepted if one of the following conditions are met:
 - a. The hangers shall be detailed to avoid significant bending of the hangers and their attachments. The maximum stress due to combined loading including bending in the hangers must be less than 21.6 ksi.
 - b. Isolation hangers are added to hanger rod to provide swivel joint and to prevent bending moment in hanger.
3. Space lateral supports a maximum of 30' o.c. (9 m), and longitudinal supports a maximum of 60' (18 m) o.c.
4. Duct risers shall be restrained at floor penetrations every 30' (9 m) maximum spacing.

5. Fire damper locations may be used as restraint locations for all directions except away from the damper.
6. Brace a change of direction longer than 12' (3.7 m).
7. Install restraint cables so they do not bend across edges of adjacent equipment or building structure.

D. Piping Systems:

1. For projects with a Seismic Design Category of C, provide seismic cable restraints on the following:
 - a. All piping systems assigned a component importance factor, I_p , of 1.5 with a nominal pipe diameter greater than 2" (50 mm) or trapeze-supported piping with combined operating weight over 10 lbs/ft (15 kg/m).
2. For projects with a Seismic Design Category of D, E or F, provide seismic cable restraints on the following:
 - a. All piping greater than 3" (75 mm) nominal diameter.
 - b. All piping systems assigned a component importance factor, I_p , of 1.5 with a nominal pipe diameter greater than 1" (25 mm) or trapeze-supported piping with combined operating weight over 10 lbs/ft (15 kg/m).
3. "12-inch rule", where pipe can be exempted from seismic restraint based on the length of the support rods, is accepted if one of the following conditions are met:
 - a. Hangers are detailed to avoid bending of the hangers and their attachment; and provisions are made for piping to accommodate expected deflections. The maximum stress due to combined loading including bending in the hangers must be less than 21.6 ksi.
 - b. Isolation hangers are added to hanger rod to provide swivel joint and to prevent bending moment in hanger.
4. Restraint spacing:
 - a. For ductile piping, space lateral supports a maximum of 40' (12 m) o.c., and longitudinal supports a maximum of 80' (24 m) o.c.
 - b. For non-ductile piping (e.g., cast iron, PVC) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.
 - c. For piping with hazardous material inside (e.g., natural gas, medical gas) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.
 - d. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.

5. Brace a change of direction longer than 12' (3.7 m).
6. Longitudinal restraints for single pipe supports shall be attached directly to the pipe, not to the pipe hanger.
7. For supports with multiple pipes (trapezes), secure pipes to trapeze member with clamps approved for application.
8. Piping on roller supports shall include a second roller support located on top of the pipe at each restraint location to provide vertical restraint.
9. Install restraint cables so they do not bend across edges of adjacent equipment or building structure.
10. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.
11. Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.
12. Coordinate seismic restraints with thermal expansion compensators, guides and anchor points. Thermal expansion anchor points shall be designed to accommodate seismic forces.

3.16 INSTALLATION OF EQUIPMENT

- A. Unless otherwise indicated, mount all equipment and install in accordance with manufacturer's recommendations and approved submittals.
- B. Maintain manufacture recommended minimum clearances for access and maintenance.
- C. Where equipment is to be anchored to structure, furnish and locate necessary anchoring and vibration isolation devices.
- D. Furnish all structural steel, such as angles, channels, beams, etc. required to support all piping, ductwork, equipment and accessories installed under this Division. Use structural supports suitable for equipment specified or as indicated. In all cases, support design will be based upon data contained in manufacturer's catalog.
- E. Openings: Arrange for necessary openings in buildings to allow for admittance and reasonable maintenance or replacement of all equipment furnished under this Contract.
- F. Access Doors: Provide as necessary for reasonable maintenance of all equipment valves, controls, etc.

END OF SECTION 23 05 00

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SECTION 23 05 05 - SELECTIVE DEMOLITION FOR HEATING, VENTILATING, AND AIR
CONDITIONING (HVAC)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work specified in this Section includes the demolition, removal, and disposition of certain mechanical work.
- B. Drawings, the provisions of the Agreement, and Administrative Specification Sections apply to all work of this Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.
- B. Do not begin installation until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 DEMOLITION, REMOVAL AND DISPOSITION

- A. Saw-cut concrete as shown or required.
- B. Piping, Ductwork, And Equipment To Be Removed: Remove all piping, ductwork, and equipment as indicated on the Drawings.
- C. Piping Removed: Drawings do not show all existing piping which is to be removed. Unless indicated otherwise, where existing equipment has been removed, or its use replaced by new equipment, remove connecting piping back to the branch in the main so that there will be no dead ends or unused pipe lines in mechanical spaces at completion.
- D. Piping, Ductwork, Equipment, Control Wiring and Tubing To Be Removed: Remove all piping, ductwork, equipment, control wiring and tubing as indicated. Drawings do not show all existing piping, ductwork, equipment, control wiring and tubing which is to be removed. Unless indicated otherwise, where existing equipment has been removed, or its use replaced by new equipment, remove connecting piping and ductwork back to the branch in the main so that there will be no dead ends or unused pipe lines in mechanical spaces at completion.

- E. Materials To Owner: All items or materials removed from the project shall be made available for the Owner's inspection. The Owner retains the option to claim any item or material. The Contractor shall deliver any claimed item or material in good condition to the place designated by the Owner. All items not claimed become the property of the Contractor and shall be removed from the site by the Contractor.
- F. Materials To Owner: As indicated on the Drawings.
- G. Re-use Of Materials: Only were indicated on Drawings.
- H. Materials To Contractor: Materials shown or specified to be removed, other than the materials indicated to be turned over to Owner.
- I. Protect any active piping and/or wiring encountered; remove, plug or cap utilities to be abandoned. Notify the Architect of utilities encountered whose service is not known.
- J. Debris Removal: Existing materials removed and not reinstalled or turned over to the Owner shall be immediately removed from the site and disposed of by the Contractor.
- K. Repairs: Any portion of the facility damaged, cut back or made inoperable by this Contractor shall be repaired with similar materials as the existing structure and/or damaged item as instructed by the Architect.

END OF SECTION 23 05 05

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

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Air Systems:

1. Constant Volume Air Systems.

1.2 SCOPE

- A. Furnish the professional services of a qualified and approved balancing and testing firm to perform the work of this specification section.

- B. The work of this section includes but is not necessarily limited to:

1. Testing and balancing existing hydronic heating and ventilation systems as indicated on drawings.
2. Testing and balancing fans and air handling systems.
3. Working directly with the control subcontractor to obtain proper system adjustments.

- C. The work of this section does not include:

1. Adjusting burners for proper combustion operation.
2. Liquid waste transfer system adjustment.
3. Fire protection systems.

1.3 APPLICABLE CODES AND STANDARDS

- A. SMACNA Manual for the Balancing and Adjustment of Air Distribution Systems.
- B. AMCA Publication 203, Field Performance Measurements.
- C. American Air Balancing Council (AABC) Recommended Procedures
- D. National Environmental Balancing Bureau (NEBB) Recommended Procedures

1.4 QUALIFICATION OF THE BALANCING FIRM OR COMPANY

A. Subcontractor minimum qualifications include:

1. NEBB Certified in Testing, Adjusting and Balancing of Air and Hydronic Systems or Demonstration of satisfactory completion of five projects of similar scope in the State of Alaska during the past five years. Provide references if requested.

1.5 TIMING OF WORK

- A. Do not begin balancing and testing until the systems, including controls, are completed and in full working order.
- B. Schedule the testing and balancing work in cooperation with other trades.
- C. Complete the testing and balancing at least one week before the date of substantial completion and before any occupancy occurs

1.6 CONTRACTOR RESPONSIBILITY TO BALANCING AGENCY

- A. Award the test and balance contract to an approved firm or company upon receipt of contract to allow the Balance and Testing Agency to schedule this work in cooperation with other trades involved and comply with completion date.
- B. Put all heating, ventilating and air conditioning systems, equipment and controls into full operation for the Balancing Agency and continue the operation of same during each working day of testing balancing.
- C. Provide scaffolding, ladders and access to each system for proper testing balancing.
- D. Ensure that the building enclosure is complete, including but not limited to, structural components, windows and doors installed, door hardware complete, ceilings complete, stair, elevator and mechanical shafts complete, roof systems complete, all plenums sealed, etc.
- E. Make any changes in pulleys, belts and dampers, or add any dampers as required for correct balance as recommended by the Balance and Testing Agency at no additional cost to the Owner.
- F. Complete installation, programming (including design parameters and graphics), calibration, and startup of all building control systems.
- G. Require that the building control system firm provide access to hardware and software, or onsite technical support required to assist the TAB effort. The hardware and software or the onsite technical support shall be provided at no cost to the TAB firm.

1.7 REPORT

- A. Certified Reports shall be included in project O & M manuals. Reports shall include: testing, adjusting, and balancing reports bearing the signature of the Test and Balance Agency Representative. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the system. Follow the procedures and format specified below:
1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports.
 2. Final Reports: Upon verification and approval of the draft report; prepare final reports, typewritten, organized and formatted as specified below.
 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted and balanced. Report shall be provided in electronic PDF Format. The data in the electronic file shall be arranged and indexed. Divide the contents into the below listed sections, with bookmarks for each section:
 - a. General Information and Summary.
 - b. Air Systems.
 - c. Hydronic Systems.
 - d. Temperature Control Systems.
 - e. Special Systems.
 - f. System Deficiency Reports and Corrective Actions.
 4. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency; contractor; owner, architect, engineer and project. Include addresses, contact names and telephone numbers. Also, include a certification sheet containing the name, address, telephone number and signature of the Certified Test and Balance Personnel. Include in this division a listing of the instrumentation used for the procedures along with the proof of calibration.

- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.8 SUBMITTALS

- A. Submit in accordance with Division 01.
- B. Submit balancing agency qualifications and sample balancing forms.
- C. Provide list of equipment to be used and date of last calibration.
- D. Submit preliminary balance report a minimum of one week prior to substantial completion inspection.

PART 2 - PRODUCTS

2.1 INSTRUMENTS

- A. Maintain all instruments accurately calibrated and in good working order. Use instruments with the following minimum performance characteristics.
 - 1. Air Velocity Instruments: Direct reading in feet per minute, 2% accuracy.
 - 2. Static Pressure Instruments: Direct reading in inches' water gauge, 2% accuracy.
 - 3. RPM Instruments: Direct reading in revolutions per minute, .5% accuracy; or revolution counter accurate within 2 counts per 1,000.
 - 4. Pressure Readout: Direct reading in feet of water or PSI, .5% accuracy.
 - 5. Temperature Instruments - Direct reading in degrees F, +.5% accuracy.
 - 6. Water Flow Instruments: Differential pressure type; direct reading in feet of water or PSI, accuracy, suitable for readout balancing valve provided.
 - 7. Sound Measuring Instrument: Octave Band Analyzer which essentially complies to AASA Standards SI.6 1960 with a range of 24DB to 150 DB sound pressure level ref. .0002 microbar. Calibrate sound test instrument before use to a closed coupler and a driving loudspeaker that produces a know-sound pressure level at the microphone of the analyzer.

PART 3 - EXECUTION

3.1 GENERAL PROCEDURES FOR ALL SYSTEMS

- A. Start with new, clean filters.
- B. In cooperation with the control manufacturer's representative, coordinate adjustments of automatically operated dampers and valves to operate as specified, indicated and/or noted.
- C. Use manufacturer's ratings on all equipment to make required calculations.
- D. Make final adjustments for each space per heating or cooling comfort requirement. State reason for variance from design CFM, i.e., "too noisy", "drafty", etc.
- E. Mark equipment and balancing device settings (including damper-control positions, valve position indicators, fan-speed-controls, and similar controls and devices) with paint or other suitable permanent identification material to show final settings.

3.2 REQUIREMENTS FOR ALL AIR HANDLING SYSTEMS

- A. Identify each diffuser, grille and register as to location and area.
- B. Identify and list size, type and manufacturer of diffusers, grilles, registers and all testing equipment.
- C. In readings and tests of diffusers, grilles and registers, include required FPM velocity and required CFM and test CFM after adjustments. If test apparatus is designed to read CFM directly, velocity reading may be omitted. Identify test apparatus used. Identify wide open (W.O.) runs.
- D. Check and record the following items:
 - 1. Air temperatures; mixed air, after coils, outside air, return air and supply air.
 - 2. Pressure drop at each coil, filter bank, etc.
 - 3. Operating suction and discharge pressure.
 - 4. Full nameplate data of all equipment.
 - 5. Rated and actual running amperage and voltage of all motors.
 - 6. Drive data including sheaves and belts and adjustments.
 - 7. Electrical overloads/heaters sizes and ranges of motors.

3.3 BALANCING LOW VELOCITY CONSTANT VOLUME DUCTWORK

- A. Analyze system and identify major branches. Tabulate design CFM for each branch.
- B. Select the branch which appears to be the longest run from the fan or to have the highest static pressure requirements.
- C. Adjust other branch dampers or the fan to establish 110% design air flow through the selected branch.
- D. Adjust the air flow through each air inlet (exhaust systems) or outlet (supply systems) on the selected branch to within +5% of the requirements so that at least one branch damper serving an inlet (or outlet) is wide open.
- E. Proceed to another branch and set up 110% design airflow. Balance each inlet or outlet to within +5% of requirements, again leaving at least one wide open run. Repeat this process until all branches are balanced 110% airflow.
- F. Once each branch has been balanced at 110% flow with one wide open run on each branch, balance with branches together, leaving at least one branch damper wide open. At this point, adjust the fan delivery so that each branch is at about 110% design airflow. Adjust the branch dampers so that each inlet (or outlet) in the system is within 10% of the required airflow.
- G. Adjust the fan for design airflow.
- H. Read and record the airflow at each inlet and outlet.
- I. Secure each branch damper and mark the balanced position of the damper quadrant.
- J. Test and record entering and leaving air temperatures of coils.
- K. Test and record entering and leaving water temperatures of coils.
- L. Test and record static pressure drop across each filter and coil bank.

END OF SECTION 23 05 93

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment Insulation.
- B. Ductwork Insulation.
- C. Ductwork Linings.
- D. Jackets and Accessories.

1.2 RELATED WORK

- A. Division 09 - Painting.
- B. Section 23 05 00 - Common Work Results for HVAC Systems.
- C. Section 23 31 00 - HVAC Ducts and Casings.
- D. Section 23 33 00 - Air Duct Accessories.

1.3 REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-alloy Sheet and Plate.
- B. ASTM C195 - Mineral Fiber Thermal Insulating Cement.
- C. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- E. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- F. ANSI/ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- G. ANSI/ASTM C547 - Mineral Fiber Pipe Insulation (Preformed).
- H. ANSI/ASTM C552 - Cellular Glass Thermal Insulation.
- I. ANSI/ASTM C553 - Mineral Fiber Blanket Insulation.

- J. ANSI/ASTM C578 - Preformed, Block Type Cellular Polystyrene Thermal Insulation.
- K. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- L. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- M. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- N. ASTM C610 - Expanded Perlite Block and Pipe Thermal Insulation.
- O. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- P. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- Q. ASTM C1427 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- R. ASTM D774 - Standard Test Method for Bursting Strength of Paper.
- S. ASTM D1000 - Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
- T. ASTM E84 - Surface Burning Characteristics of Building Materials.
- U. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- V. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. Submit product data under provisions of Division 01.
- B. Include product description, thickness for each service, and locations.
- C. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with three years minimum experience.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Materials: Flame spread/smoke developed rating of 25/50 in accordance with UL 723, ASTM E84, or NFPA 255.
- D. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Shipment of materials from manufacturer to installation location shall be in weather tight transportation.
- D. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesive, mastics, and insulation cements.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Armacell.
- B. Certain-Teed.
- C. IMCOA.
- D. Johns Manville.
- E. Knauf.
- F. Owens-Corning.
- G. Manson.
- H. Nomaco.

- I. Pittsburgh - Corning.
- J. K-Flex USA.
- K. Armstrong.
- L. Substitutions: Under provisions of Division 01.

2.2 INSULATION – DUCTWORK

- A. Type N: Duct Liner: Close cell, CFC- and HCFC-free flexible elastomeric acoustical insulation with scrim-reinforced acrylic adhesive on one side; ASTM C534 type 2 (sheet) grade 1, ASTM E84 25/50 at 2" and below; 'k' value of 0.25 at 75° F; R-4.2 and noise reduction coefficient (NRC) of 0.5 at 1" thick; recommended for -40 to 200° F temperature applications; install metal nosing for air velocities greater than 4,000 ft./min., UL listed adhesive galvanized steel pins. K-flex USA "K-flex duct liner gray" or approved equal.

2.3 FIELD APPLIED EQUIPMENT AND DUCTWORK JACKETS

- A. Aluminum Jackets: ASTM B209; 0.016 inch thick; corrugated or textured finish, longitudinal slip joints.
- B. Stainless Steel Jackets: Type 304 stainless steel; 0.010 inch thick; corrugated finish.
- C. Re-Wettable Canvas Jacketing: , Fiberglass cloth made from texturized yarns, impregnated throughout with an inorganic fire retardant asbestos free adhesive; 20x14 thread count, 14.5 oz./sq.yd, 0.04 inch thickness, 1,000° F upper temperature limit; GLT Products "Style 1989" or approved equal.

2.4 INSULATION ACCESSORIES

- A. Adhesives: Waterproof and fire-retardant type.
- B. Lagging Adhesive: Fire resistive to NFPA 255.
- C. Impale Anchors: Galvanized steel, 12 gauge, self-adhesive pad.
- D. Joint Tape: Glass fiber cloth, open mesh.
- E. FSK Joint Tape; ASTM C1136 Foil-Scrim-Kraft (FSK) lamination coated with solvent acrylic pressure sensitive adhesive; capable of adhering to fibrous and sheet metal surfaces; tri-directionally reinforced 2x3 squares per inch fiberglass scrim; 9.5 mils thick, -40 to 240° F service temperatures; Venture Tape "1525CW" or approved equal.
- F. Tie Wire: Annealed steel, 16 gauge.
- G. Insulated pipe supports: Calcium silicate with galvanized steel jacket (min. 24 gauge); ANSI/ASTM C533; rigid white; 'k' value of 0.37 at 100° F, rated to 1,200° F; Thermal Pipe Shields "T-1000 Calsil" or equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install materials after piping, equipment and ductwork has been tested and approved.
- B. Clean surfaces for adhesives.
- C. Prepare surfaces in accordance with manufacturer's recommendations.

3.2 INSTALLATION – DUCTWORK INSULATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Provide insulation with vapor barrier when air conveyed may be below ambient temperature. Continue insulation with vapor barrier through penetration.
- C. Where canvas jacketing is indicated, apply mastic in sufficient thickness to completely cover the texture of the canvas material.

3.3 SCHEDULE - DUCTWORK

DUCTWORK	TYPE	INSULATION THICKNESS	FINISH
Exhaust & Relief Ducts Within 10 ft. of Exterior Openings	N	1"	FSK
Supply Ducts	N	1"	FSK

END OF SECTION 23 07 00

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SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Pipe and pipe fittings.
- B. Valves.

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC

1.3 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.

1.4 SUBMITTALS

- A. Submit product data under provisions of Division 01.
- B. Include data on pipe materials, pipe fittings, valves and accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 01.
- B. Store and protect products under provisions of Division 01.
- C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING, ABOVE GRADE

- A. Piping: Steel Pipe ASTM A53, Schedule 40 black. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, forged steel welding type.
- B. Joints:

1. Low pressure, 2" and under: Screwed or Viega MegaPressG Cold Press Mechanical Joint. Press fittings are acceptable to last tee for connection to the appliance. Utilize threaded piping at the last tee.
2. Medium pressure or larger than 2": ANSI/AWS D1.1, welded or Viega MegaPressG Cold Press Mechanical Joint. Press fittings are acceptable to last tee for connection to the appliance. Utilize threaded piping at the last tee.

2.2 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; 1/16 inch thick preformed neoprene bonded to fiber.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 ACCEPTABLE MANUFACTURERS – GAS COCKS AND BALL VALVES

- A. Apollo.
- B. Hammond.
- C. Milwaukee.
- D. Nibco.
- E. Substitutions: Under provisions of Division 01

2.4 GAS COCKS

- A. Up to 2 Inches: Bronze body, bronze tapered plug. non-lubricated, Teflon packing, threaded ends.
- B. Over 2 Inches: Cast iron body and plug, non- lubricated, Teflon packing, flanged ends.

2.5 BALL VALVES

- A. Up to 2 Inches: Bronze two piece body, full port, forged brass, chrome plated ball, Teflon seats and stuffing box ring, lever handle, solder, threaded or press-fit ends.
- B. Over 2 Inches: Cast steel, two piece body, full port chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged, solder, threaded or press-fit ends.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Verify that excavations are to required grade, dry, and not over excavated.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Install valves with stems upright or horizontal, not inverted.

3.3 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.4 TESTING

- A. Test all piping in accordance with IFGC and UPC requirements. The test pressure used shall be no less than 10 times the proposed maximum working pressure, but not less than 10 psig for low pressure gas systems (7 inch WC) or 60 psig for medium pressures gas systems (2 psig or 5 psig). All welded pipe shall be tested with not less than 60 psig test pressures.

END OF SECTION 23 11 23

SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Duct Materials.
2. Single Wall Spiral Round Ducts.
3. Ductwork Fabrication.

1.2 RELATED SECTIONS

- D. Section 23 07 00 - HVAC Insulation: Product requirements for duct liners for placement by this section.
- E. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.3 REFERENCES

A. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
4. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
5. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

8. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
9. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Air Duct Leakage Test Manual.
2. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.

1.4 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Three pressure classifications: ½ inch WG positive or negative static pressure and velocities less than 2,000 fpm; 1 inch WG positive or negative static pressure and velocities less than 2,500 fpm and 2 inch WG positive or negative static pressure and velocities less than 2,500 fpm.
- C. Medium Pressure: Three pressure classifications: 3 inch WG positive or negative static pressure and velocities less than 4,000 fpm, 4 inch WG positive static pressure and velocities greater than 2,000 fpm, 6 inch WG positive static pressure and velocities greater than 2,000 fpm.
- D. High Pressure: 10 inch WG positive static pressure and velocities greater than 2,000 fpm.

1.5 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.6 SUBMITTALS

- A. See General Conditions and the General Requirements in Division 01 regarding submittals.
- B. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 1/8" inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
 1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.

2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
3. Fittings.
4. Reinforcing details and spacing.
5. Seam and joint construction details.
6. Penetrations through fire rated and other walls.
7. Terminal unit, coil, and humidifier installations.
8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

C. Product Data: Submit data for duct materials.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.7 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.8 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

B. Construct ductwork to NFPA 90A standards.

C. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

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

B. Installer: Company specializing in performing Work of this section with minimum three years documented]experience approved by manufacturer.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements.

- B. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
- C. Maintain temperatures during and after installation of duct sealant.

1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.12 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 DUCT MATERIALS

- A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90/A90M.
- B. Steel Ducts: ASTM A568/A568M.
- C. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.
- D. Stainless Steel Ducts: ASTM A167, Type 304.
- E. Concrete Ducts: ASTM C14; hub and spigot concrete sewer pipe with ASTM C443 joints, rubber gaskets.
- F. Fasteners: Rivets, bolts, or sheet metal screws.
- G. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 LOW PRESSURE DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.
- C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where

acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30° divergence upstream of equipment and 45°convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- G. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.
- H. Connect flexible ducts to metal ducts with draw bands.
- I. Use crimp joints with or without bead for joining round duct sizes 12” and smaller with crimp in direction of airflow.
- J. Use double nuts and lock washers on threaded rod supports.

2.3 SINGLE WALL SPIRAL ROUND DUCTS

- A. Manufacturers:
 - 1. McGill AirFlow Corporation
 - 2. Spiral Mfg. Co., Inc.
 - 3. Semco Incorporated.
 - 4. Tangent Air Corp Model.
 - 5. Local Manufacturer.
 - 6. Substitutions: Division 01 - Product Requirements. Not Permitted.
- B. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel.
- C. Construct duct with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	26

- D. Construct fittings with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	24

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Install glass fiber ducts in accordance with SMACNA Fibrous Glass Duct Construction Standards. Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.
- C. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 12" and smaller.
- E. Install duct hangers and supports in accordance with Section 23 05 00.
- F. Use double nuts and lock washers on threaded rod supports.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect diffusers or light troffer boots to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.
- C. Connect air outlets and inlets to supply ducts directly.

3.4 SCHEDULES

A. Ductwork Material Schedule:

Air System	Material
Low Pressure Supply	Steel
General Exhaust	Steel

END OF SECTION 23 31 00

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SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Back-draft Dampers.
2. Volume Control Dampers.
3. Turning Vanes.

1.2 RELATED SECTIONS

- A. Section 23 31 00 - HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.
- B. Division 26 - Equipment Wiring Connections: Execution requirements for connection of electrical Combination Smoke and Fire Dampers specified by this section.

1.3 REFERENCES

- A. Air Movement and Control Association International, Inc.:
1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. ASTM International:
1. ASTM E1 - Standard Specification for ASTM Thermometers.
- C. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 2. NFPA 92A - Recommended Practice for Smoke-Control Systems.
- D. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- E. Underwriters Laboratories Inc.:
1. UL 555 - Standard for Safety for Fire Dampers.
 2. UL 555C - Standard for Safety for Ceiling Dampers.

3. UL 555S - Standard for Safety for Smoke Dampers.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers and duct access doors.
- C. Product Data: Submit data for shop fabricated assemblies and hardware used.
- D. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
 1. Backdraft dampers.
 2. Volume control dampers.
 3. Duct test holes.
- E. Product Data: For fire dampers, smoke dampers, and combination fire and smoke dampers submit the following:
 1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
 2. Indicate materials, construction, dimensions, and installation details.
 3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- F. Manufacturer's Installation Instructions: Submit for Fire and Combination Smoke and Fire Dampers.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of access doors and test holes
- C. Operation and Maintenance Data: Submit for Combination Smoke and Fire Dampers.

1.6 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

- C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

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

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Protect dampers from damage to operating linkages and blades.
- C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- D. Storage: Store materials in a dry area indoor, protected from damage.
- E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 COORDINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work where appropriate with building control Work.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

1.12 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each size and type of fusible link.

1.13 COMPLETION REQUIREMENTS

- A. In accordance with the General Conditions and the General Requirements in Division 01, Project Closeout; before acceptance and final payment, the Contractor shall furnish:

1. Accurate project record drawings, shown in red ink on prints, showing all changes from the original plans made during installation of the work.
2. Contractors One Year Warranty.
3. All Manufacturers' Guarantees.
4. Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 BACK-DRAFT DAMPERS

- A. Manufacturers:
 1. Ruskin.
 2. Greenheck.
 3. Penn.
 4. Substitutions: Division 01 - Product Requirements.
- B. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.
- C. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gauge galvanized steel, or extruded aluminum, with center pivoted blades of maximum 6" width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.2 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Fabricate splitter dampers of material same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.
- C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
- D. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.
- E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

- F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends. Where volume dampers are located above gypsum or other non-accessible ceilings, extend damper rods to ceiling and install recessed concealed regulator with adjustable cover for flush installation, with cover. Exposed portions shall be chrome plated. Regulator shall include spring washer, lock nut, coupling, ninety degree screw or gear drive and rod as required, Young Regulator or equal. Coordinate location of access covers with Architect.
- H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.3 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.4 TURNING VANES

- A. Double Width: Air foil design double width galvanized turning vanes with 2 inch inside radius.
- B. Single Width: Single galvanized turning vane with 2 inch radius and minimum 1" trailing straight leg.
- C. Acoustical Vanes: Double width vanes with inner vane of perforated galvanized steel with 3/32 inch holes on 5/32 inch spacing. Fill space between vanes with minimum 1.5 lb/cu ft glass fiber duct liner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify rated walls are ready for fire damper installation.
- C. Verify ducts and equipment installations are ready for accessories.
- D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Access Doors: Install access doors at the following locations and as indicated:
 - 1. Spaced every 50 feet of straight duct.
 - 2. Upstream of each elbow.
 - 3. Before and after each automatic control damper.
- D. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- E. Install temporary duct test holes as required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Inspect turning vanes for proper and secure installation.
 - 4. Operate remote damper operators to verify full range of movement of operator and damper.

3.4 DEMONSTRATION

- A. Division 01 - Execution and Closeout Requirements: Requirements for demonstration and training.

END OF SECTION 23 33 00

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Upblast centrifugal roof fans.

B. Related Sections:

1. Section 23 05 00 - Common Work Results for HVAC.
2. Section 23 05 93 - Testing, Adjusting and Balancing.
3. Section 23 07 00 - HVAC Insulation.
4. Section 23 31 00 - HVAC Ducts and Casings.
5. Section 23 33 00 - Air Duct Accessories.
6. Division 26 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this section.

1.2 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

C. American Refrigeration Institute:

1. ARI 1060 - Air-to-Air Energy Recovery Ventilation Equipment Certification Equipment Program.
- D. National Electrical Manufacturers Association:
 1. NEMA MG 1 - Motors and Generators.
 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. Underwriters Laboratories Inc.:
 1. UL 705 - Power Ventilators.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of 23 05 00 Common Work Results for HVAC.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Submit shop drawings and product data under provisions of 23 05 00 Common Work Results for HVAC.
- B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- D. Balance Quality: Conform to AMCA 204.

- E. Energy Recovery Unit Wheel Energy Transfer Rating: Meet ARI 1060.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 01 in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs.
- B. Protect motors, shafts, and bearings from weather and construction dust.
- C. Protect motors, shafts, and bearings from weather and construction dust.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 WARRANTY

- A. Provide warranty under provisions of 23 05 00 Common Work Results for HVAC: Product warranties and product bonds.
- B. Furnish five year manufacturer's warranty for fans.

1.10 EXTRA MATERIALS

- A. Furnish two sets of belts for each fan.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Greenheck Corp.
- B. Loren Cook Company.
- C. Twin City.
- D. Substitutions: Under provisions of Division 01.

2.2 GENERAL

- A. Fans used shall not decrease motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Fans shall be capable of accommodating static pressure variations of plus or minus 10 percent.
- B. Base performance on sea level conditions unless otherwise noted.
- C. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.

2.3 UPBLAST CENTRIFUGAL ROOF FANS

- A. Fan Unit: Upblast type, centrifugal backward inclined. Aluminum fan wheel and rub ring, non-sparking V-belt drive, with spun aluminum housing; resilient mounted motor; aluminum wire bird screen; square base to suit roof curb with continuous curb gaskets.
- B. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- C. Motor: Open drip proof.
- D. Accessories:
 - 1. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked and line voltage motor drive, power open, spring return.
 - 2. Disconnect Switch: Factory wired, NEMA ICS 2, AC general purpose Class A, manually operated unit with number of poles as required by the load served, full-voltage controller for thermal overload protected fractional horsepower induction motors with thermal overload unit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 PREPARATION

- A. Coordinate with other trades for installation of roof curbs. Refer to requirements of Division 07 for installation.

3.3 INSTALLATION

- A. Secure roof fans stainless steel lag screws to roof curb.
- B. Install backdraft dampers on inlet to roof exhaust fans.
- C. Provide backdraft dampers on outlet from cabinet and ceiling fans and as indicated on Drawings.
- D. Install safety screen where inlet or outlet is exposed.
- E. Provide sheaves required for final air balance for belt driven fans. Refer to requirements Section 23 05 93.

3.4 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.5 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.6 PROTECTION OF FINISHED WORK

- A. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION 23 34 00

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SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Diffusers.

1.2 REFERENCES

- A. ADC 1062 - Certification, Rating and Test Manual.
- B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- D. ARI 650 - Air Outlets and Inlets.
- E. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- F. SMACNA - HVAC Duct Construction Standard.

1.3 QUALITY ASSURANCE

- A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate performance of louvers in accordance with AMCA 500.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A.
- B. Earthquake tabs, in seismic zones, in accordance with IBC Standards.

1.5 SUBMITTALS

- A. Submit product data under provisions of Division 01.
- B. Provide product data for items required for this project.
- C. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – DIFFUSERS, REGISTERS AND GRILLES

- A. Krueger.
- B. Price.
- C. Titus.
- D. Substitutions: Under provisions of Division 01.

2.2 DUCT MOUNTED SUPPLY DIFFUSERS

- A. Streamlined double deflection blades, fixed orientation parallel to long dimension of grille.
- B. Fabricate 1-1/4 inch margin frame with countersunk screw mounting.
- C. Fabricate of steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory baked enamel off-white finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with manufacturers' instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with airtight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION 23 37 00

SECTION 23 74 23.13 - PACKAGED, DIRECT-FIRED, OUTDOOR, HEATING-ONLY MAKEUP-AIR UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Direct Fired Make-up Air Heater.
- B. Controls.

1.2 REFERENCES

- A. ANSI/ASHRAE - 90A - Energy Conservation in New Building Design.
- B. ANSI/Z223.1 (NFPA 54) - National Fuel Gas Code.
- C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

- A. Submit product Data: Indicate dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation data under provisions of Division 01.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.5 WARRANTY

- A. Provide five year warranty under provisions of Division 01.

1.6 EXTRA MATERIALS

- A. Provide two sets of spare filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Greenheck.
- B. Rupp.
- C. Reznor.
- D. Substitutions: Under provisions of Division 01.

2.2 MANUFACTURED UNITS

- A. Unit: Outdoor unit.
- B. Testing: ASHRAE 14.
- C. Performance Ratings: Energy Efficiency Rating (EER) not less than requirements of ANSI/ASHRAE 90A.

2.3 FABRICATION

- A. Casing and Components: Double wall steel Panels, 18 gage (1.2 mm) reinforced with structural angles and channels to ensure rigidity; access panels to burner and blower motor assemblies from side of unit.
- B. Observation Port: On burner section for observing main and pilot flames.
- C. Insulation: Neoprene faced glass fiber insulation one inch thick on complete unit, between casing panels.
- D. Finish: Heat resistant baked enamel.
- E. Suspended Installations: Service platforms complete with handrails and access ladder.
- F. Outdoor Installation: Weatherproofed casing, with intake louver or hood.

2.4 FILTERS

- A. Filter: Removable one inch thick glass fiber disposable filters in metal frames.

2.5 BURNERS

- A. Assembly: For natural gas, capable of modulating turn down ratio of 25:1, including modulating main gas valve, motorized shut down valve, main and pilot gas regulators, pilot electric gas valve, manual shut-off valve and pilot adjustment valve.
- B. Pilot: Electrically ignited by spark rod through high voltage ignition transformer and supervised.
- C. Damper: Motorized with end switch to prove position before burner will fire.

2.6 FAN

- A. Fan: Statically and dynamically balanced centrifugal fan mounted on solid steel shaft with heavy duty self-aligning pre-lubricated ball bearings and V-belt drive with matching motor sheaves and belts.

2.7 CONTROLS

- A. Controls: Pre-wire unit for connection of power supply. Field wiring from unit to remote control panel makes unit operative.
- B. Remote Control Panel: On-off-auto switch, summer-winter switch, indicating lights for supply fan, pilot operation, burner operation, clogged filter indication and lockout indication.
- C. Fan Discharge Thermostat: Controls modulating gas valve to maintain supply air temperature. Provide remote discharge thermostat adjustment. Provide room thermostat.
- D. Safety Controls: Sense correct air flow before energizing pilot and sense pilot ignition before activating main gas valve.
- E. Manual Reset Low and High Limit Controls: Maintain supply air temperature between set points and shut fan down if temperatures are exceeded.
- F. Purge Period Timer: Automatically delays burner ignition and bypass low limit control.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install to NFPA 90A.
- C. Install to NFPA 54.

END OF SECTION 23 74 23.13

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DIVISION 26

ELECTRICAL

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General Requirements specifically applicable to Division 26, in addition to Division 01 provisions.
- B. The electrical system equipment and installation shall comply with all provisions and requirements of this specification, as well as any and all applicable national, state and local codes and standards.

1.2 WORK SEQUENCE

- A. Construct Work in sequence under provisions of Division 01.

1.3 COORDINATION

- A. Coordinate the Work specified in this Division under provisions of Division 01.
- B. Prepare drawings showing proposed rearrangement of Work to meet job conditions, including changes to Work specified under other Sections. Obtain permission of Architect prior to proceeding.

1.4 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code, latest adopted edition including all state and local amendments.
- B. NECA - Standard of Installation.
- C. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. Electrical Reference Symbols: The Electrical "Legend" on drawings is standardized version for this project. All symbols shown may not be used on drawings. Use legend as reference for symbols used on plans.
- E. Electrical Drawings: Drawings are diagrammatic; complimentary to the Architectural drawings; not intended to show all features of work. Install material not dimensioned on drawings in a manner to provide a symmetrical appearance. Do not scale drawings for exact equipment locations. Review Architectural, Civil, Structural, Instrumentation, Process, and Mechanical Drawings and adjust work to conform to conditions shown thereon. Field verification of dimensions, locations and levels is directed.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to the latest adopted edition of the International Building Code and the International Fire Code including all state and local amendments thereto.
- C. Obtain electrical permits, plan review, and inspections from authority having jurisdiction.

1.6 SUBMITTALS

- A. Submittal review is for general design and arrangement only and does not relieve the Contractor from any requirements of Contract Documents. Submittal not checked for quantity, dimension, fit or proper operation. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provisions of a complete and satisfactory working installation is the sole responsibility of the Contractor.
- B. In addition to requirements referenced in Division 01, the following is required for work provided under this division of the specification.
 - 1. Provide material and equipment submittals containing complete listings of material and equipment shown on Electrical Drawings and specified herein. Separate from work furnished under other divisions.
 - 2. Submittals shall be provided in PDF format with each section indexed in the PDF document. Submittals for Division 26 shall be complete and submitted at one time. Unless given prior approval, partial submittals will be returned unreviewed.
 - 3. Clearly identify all material and equipment by item, name or designation used on drawings and in specifications.
 - 4. Submit only pages which are pertinent; mark catalog sheets to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring diagrams and controls; component parts; finishes; dimensions; and required clearances.
 - 5. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
 - 6. Review submittals prior to transmittal; determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.
 - 7. Coordinate submittals with requirements of work and of Contract Documents.
 - 8. Certify in writing that the submitted shop drawings and product data are in compliance with requirements of Contract Documents. Notify Architect/Engineer in writing at time of submittal, of any deviations from requirements of Contract Documents.

9. Do not fabricate products or begin work which requires submittals until return of submittal with Architect/Engineer acceptance.
10. Equipment scheduled by manufacturer's name and catalog designations, manufacturer's published data and/or specification for that item, in effect on bid date, are considered part of this specification. Approval of other manufacturer's item proposed is contingent upon compliance therewith.

1.7 SUBSTITUTIONS

- A. In accordance with the General Conditions and the General Requirements, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment.

1.8 PROJECT RECORD DRAWINGS

- A. Maintain project record drawings in accordance with Division 01.
- B. In addition to the other requirements, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all electrical work which will become permanently concealed. Show routing of work in permanently concealed blind spaces within the building. Show complete routing and sizing of any significant revisions to the systems shown.
- C. Record drawing field mark-ups shall be maintained on-site and shall be available for examination of the Owner's Representative at all times.

1.9 OPERATION AND MAINTENANCE MANUALS

- A. Provide operation and maintenance manuals for training of Owner's Representative in operation and maintenance of systems and related equipment. In addition to requirements referenced in Division 01, the following is required for work provided under this section of the specifications.
- B. Manuals shall be separate from work furnished under other divisions. Prepare a separate chapter for instruction of each class of equipment or system. Index and clearly identify each chapter and provide a table of contents.
- C. Unless otherwise noted in Division 01, provide one copy of all material for approval.
- D. The following is the suggested outline for operation and maintenance manuals and is presented to indicate the extent of items required in manuals.
 1. List chapters of information comprising the text. The following is a typical Table of Contents:
 - a. Electrical power distribution.

- b. Lighting.
 - c. Other chapters as necessary.
2. Provide the following items in sequence for each chapter shown in Table of Contents:
- a. Describe the procedures necessary for personnel to operate the system including start-up, operation, emergency operation and shutdown.
 - 1) Give complete instructions for energizing equipment and making initial settings and adjustments whenever applicable.
 - 2) Give step-by-step instructions for shutdown procedure if a particular sequence is required.
 - 3) Include test results of all tests required by this and other sections of the specifications.
 - b. Maintenance Instructions:
 - 1) Provide instructions and a schedule of preventive maintenance, in tabular form, for all routine cleaning and inspection with recommended lubricants if required for the following:
 - a) Lighting fixtures.
 - b) Distribution equipment.
 - 2) Provide instructions for minor repair or adjustments required for preventive maintenance routines, limited to repairs and adjustments which may be performed without special tools or test equipment and which requires no special training or skills.
 - 3) Provide manufacturers' descriptive literature including approved shop drawings covering devices used in system, together with illustrations, exploded views, etc. Also include special devices provided by the Contractor.
 - 4) Provide any information of a maintenance nature covering warranty items, etc., which have not been discussed elsewhere.
 - 5) Include list of all equipment furnished for project, where purchased, technical representative if applicable and a local parts source with a tabulation of descriptive data of all electrical-electronic spare parts and all mechanical spare parts proposed for each type of equipment or system. Properly identify each part by part number and manufacturer.
 - c. Inspection Certificate: Include copy of certificate of final inspection and acceptance from the Authority Having Jurisdiction.

1.10 DEMONSTRATION OF ELECTRICAL SYSTEMS

A. During substantial completion inspection:

1. Conduct operating test for approval under provisions of Division 01.
2. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents.
3. Should any portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.
4. Have instruments available for measuring light intensities, voltage and current values, and for demonstration of continuity, grounds, or open circuit conditions.
5. Provide personnel to assist in taking measurements and making tests.

1.11 CERTIFICATE OF COMPLETION

A. Submit, at time of request for final inspection, a completed letter in the following format:

B. I, NAME, of FIRM, certify that the electrical work is complete in accordance with Contract Plans and Specifications, and authorized change orders (copies attached) and will be ready for final inspection as of DATE. I further certify that the following specification requirements have been fulfilled:

1. megger readings performed, copies of logs attached.
2. operating manuals completed, DATE.

SIGNED.

3. as-built drawings up-to-date and ready to deliver to Architect.
4. Instruction of operating personnel completed on DATE by:

SIGNED.

Owner's Representative

5. emergency lighting inverter system final connections, check out and start up completed on DATE by:

SIGNED.

Factory Authorized and Trained Technician

6. all other tests required by specifications have been performed.

7. ____ all systems are fully operational.

SIGNED.

1.12 WARRANTY

- A. In addition to the requirements of Division 01, or as specified in other sections. Warrant all materials, installation and workmanship for one (1) year from date of acceptance.
- B. Copies of manufacturer product warranties for all equipment shall be included in the operation and installation manuals.

1.13 INSTRUCTION OF OPERATING PERSONNEL

- A. In accordance with the requirements of Division 01 and this section provide services of qualified representative of supplier of each item or system listed below to instruct designated personnel of Owner in operation and maintenance of item or system.
- B. Certify that an Anchorage or Fairbanks based authorized service organization regularly carries complete stock of repair parts for listed equipment or systems, that organization is available and will furnish service within 48 hours after request. Include name, address and telephone number of service organization.
- C. Have approved operation and maintenance manuals and parts lists for all equipment on hand at time of instruction.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. All Materials and Equipment shall be new.
- B. All Materials and Equipment shall be listed by Underwriter's Laboratories or equivalent third party listing agency for the use intended.
- C. Materials and Equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended when installed per listing and labeling instructions.
- D. No materials or equipment containing asbestos in any form shall be used. Where materials or equipment provided by this Contractor are found to contain asbestos such items shall be removed and replaced with non-asbestos containing materials and equipment at no cost to the Owner.
- E. In describing the various items of equipment, in general, each item will be described singularly, even though there may be numerous similar items.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. Install Work using procedures defined in NECA Standard of Installation and/or the manufacturer's installation instructions.

3.2 TESTS

- A. Notify the Owner's representative at least 72 hours prior to conducting any tests.
- B. Perform additional tests required under other sections of these specifications.
- C. Perform all tests in the presence of the Owner's representative.
- D. The Contractor shall provide written notification to the Owner's representative and the City of Kenai Electrical Inspector thirty days in advance of requests for rough-in and substantial completion inspections.

3.3 PENETRATIONS OF FIRE BARRIERS

- A. All holes or voids created to extend electrical systems through fire rated floors, walls or ceiling shall be sealed with an asbestos-free intumescent fire stopping material capable of expanding 8 to 10 times when exposed to temperatures 250°F or higher.
- B. Materials shall be suitable for the fire stopping of penetrations made by steel, glass, plastic and shall be capable of maintaining an effective barrier against flame, smoke and gases in compliance with the requirements of ASTM E814 and UL 1479.
- C. The rating of the fire stops shall be the same as the time-rated floor, wall or ceiling assembly.
- D. Install fire stopping materials in accordance with the manufacturer's instructions.
- E. Unless protected from possible loading or traffic, install fire stopping materials in floors having void openings of four (4) inches or more to support the same floor load requirements as the surrounding floor.

END OF SECTION 26 05 00

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SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building Wire.
- B. Cable.
- C. Wiring Connections and Terminations.

1.2 RELATED SECTIONS

- A. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCES

- A. Federal Specification FS-A-A59544 – Cable and Wire, Electrical (Power, Fixed Installation).
- B. Federal Specification FS-J-C-30B – Cable Assembly, Power, Electrical.
- C. ANSI/NEMA WC 70-2009 – Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
- D. NETA ATS – Acceptance testing specifications for Electrical Power Distribution and Systems.
- E. NFPA 70 – National Electrical Code.
- F. NFPA 262 – Standard Method of test for flame travel and smoke of wires and cables for use in air-handling spaces.
- G. UL 62 – Flexible Cords and Cables.
- H. UL 83 – Thermoplastic Insulated Wire and Cable.
- I. UL 1063 – Standard for Machine and Tool Wire and Cable.
- J. UL 1479 – Standard for Fire Tests of Through Wall Penetration Fire Stops.
- K. UL 1569 – Standard for Metal Clad Cable.
- L. UL 1581 – Reference Standard for Electrical Wires, Cables and Flexible Cords.

1.4 SUBMITTALS

- A. Submit data under provisions of Division 01 and Section 26 05 00.
- B. Product Data: Submit product data for all components provided which fall under this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.5 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5m) when tested in accordance with NFPA 262.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Thermoplastic-insulated Building Wire: NEMA WC 70.
- B. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600 volt insulation, THW, THHN/THWN or XHHW-2 as indicated.
- C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THHN/THWN or XHHW-2. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor.
- D. Branch Circuit Wire Color Code:
 - 1. Color code wires by line or phase as follows:
 - a. Black, red, blue and white for 120/208V systems.
 - b. Brown, orange, yellow and gray for 277/480V systems.
 - 2. For conductors 6 AWG and smaller, insulation shall be colored. For conductors 4 AWG and larger, identify with colored phase tape at all terminals, splices, and boxes.
 - 3. Grounding conductors 6 AWG and smaller shall have green colored insulation. For 4 AWG and larger, use green tape at both ends and at all other visible points in between, including pull and junction boxes.
- E. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THNN or XHHW-2.

2.2 REMOTE CONTROL AND SIGNAL CABLE

- A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 90° C, individual conductors twisted together, shielded, and covered with an overall PVC jacket; UL listed.
- B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 90° C, individual conductors twisted together, shielded or unshielded (as required), and covered with a PVC jacket; UL listed.
- C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 90° C, individual conductors twisted together, shielded or unshielded (as required), and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.3 WIRING CONNECTIONS AND TERMINATIONS

- A. For conductors 8 AWG and smaller:
 - 1. Dry interior areas: Spring wire connectors, pre-insulated “twist-on” rated 105 degrees C per UL 468C. Where stranded conductors are terminated on screw type terminals, install crimp insulated fork or ring terminals. Thomas & Betts Sta-Kon or equal.
 - 2. Motor connections: Spring wire connectors, pre-insulated “twist-on” rated 105 degrees C per UL 468C. Provide a minimum of 8 wraps of Scotch 33+ electrical tape around conductors and connector to eliminate connector back off.
 - 3. Wet or exterior: Spring wire connectors, pre-insulated “twist-on”, resin filled rated for direct burial per UL 486D.
 - 4. Fluorescent luminaires: UL listed, 4A, 600V, luminaire disconnect with tin-plated brass contacts, finger-safe polycarbonate female housing, 105° C temperature rating, and two or three-pole configuration to match load served.
- B. For conductors 6 AWG and larger:
 - 1. Bus lugs and bolted connections: 600 V, 90 degrees C., two hole long barrel irreversible compression copper tin plated. Thomas & Betts or approved equal.
 - 2. Motor connection: 600 V, 90 degrees C., copper tin plated compression motor pigtail connector, quick connect/disconnect, slip on insulator. Thomas & Betts or approved equal.
 - 3. Two way connector for splices or taps: 600 V, 90 degrees C., compression long barrel, copper tin plated. Thomas & Betts or approved equal. Insulate with Scotch 23 rubber insulating base covering and Scotch 33+ outer wrap.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 18 AWG for control wiring.
- B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
- C. Splice only in junction or outlet boxes.
- D. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- E. Make Conductor lengths for parallel circuits equal.
- F. Wiring in lighting fixture channels shall be rated for 90° C minimum.
- G. Do not share neutral conductors. Provide a dedicated neutral conductor for each branch circuit that requires a neutral.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Verify that raceway is complete and properly supported prior to pulling conductors. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Do not install XHHW-2 conductors when ambient temperatures are below –5 degrees C and THHN/THWN conductors when ambient temperatures are below 0 degrees C.
- D. Conductors shall be carefully inspected for insulation defects and protected from damage as they are installed in the raceway. Where the insulation is defective or damaged, the cable section shall be repaired or replaced at the discretion of the Owner and at no additional cost to the Owner.
- E. Place an equal number of conductors for each phase of a circuit in same raceway or cable.
- F. Route conductors from each system in independent raceway system and not intermix in the same raceway, enclosure, junction box, wireway, or gutter as another system unless otherwise shown on the plans.
- G. No more than six current carrying conductors shall be installed in any homerun unless otherwise indicated on the drawings or without prior approval from the Engineer.
- H. Completely and thoroughly swab raceway system before installing conductors.

- I. When two or more neutrals are installed in one conduit, identify each with the proper circuit number in accordance with Section 26 05 53.

3.3 WIRING CONNECTIONS AND TERMINATIONS

- A. Stranded wire shall not be wrapped around screw terminals.
- B. Splice only in accessible junction boxes.
- C. Thoroughly clean wires before installing lugs and connectors.
- D. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- E. Terminate spare conductors with twist on connectors or heat shrink insulation to proper voltage rating.
- F. Control systems wiring in conjunction with mechanical, electrical or miscellaneous equipment to be identified in accordance with wiring diagrams furnished with equipment.
- G. Do not exceed manufacturer's recommended pull tensions.

3.4 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 01.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Torque conductor connections and terminations to manufacturer's recommended values.

3.5 WIRE AND CABLE INSTALLATION SCHEDULE

- A. All Locations: Building wire and/or remote control and signal cable in raceways.

END OF SECTION 26 05 19

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SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Power System Grounding.
- B. Electrical Equipment and Raceway Grounding and Bonding.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

1.3 REFERENCE STANDARDS

- A. ANSI/NEMA GR-1, Ground Rod Electrodes and Ground Rod Electrode Couplings.
- B. ANSI/NFPA 70 – National Electrical Code.
- C. ASTM B 3 – Standard Specification for Soft or Annealed Copper Wire.
- D. AWS A5.8/A5.8M – Specification for Filler Metals for Brazing and Braze Welding.
- E. IEEE Std 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- F. IEEE Std 142 – Recommended Practice for Grounding of Industrial and Commercial Power System.
- G. UL 467 – Standard for Grounding and Bonding Equipment.

1.4 SYSTEM DESCRIPTION

- A. Provide a complete grounding system for services and equipment as required by State and Local Codes, NEC, applicable portions of other NFPA codes, and as indicated herein.

1.5 SUBMITTALS

- A. Product Data: Submit product data for all components provided, showing material type and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Drawings
- B. Test Reports
 - 1. Each test report shall include:
 - a. Instrument or other test equipment used.
 - b. Ground impedance in ohms.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Grounding Conductors: Copper conductor bare or green insulated.
- B. Mechanical Grounding and Bonding Connectors: Non-reversible crimp type lugs only. Use factory made compression lug for all terminations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide a separate, insulated equipment-grounding conductor in all feeder and branch circuits. Terminate each end on a grounding lug, bus, or bushing. Multiple conductors on single lug not permitted. Each grounding conductor shall terminate on its own terminal lug.
- B. Bond together exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables and receptacle ground connectors.
- C. Grounding conductors for branch circuits shall be sized in accordance with NEC, except minimum size grounding conductor shall be No. 12 AWG.
- D. Grounding conductor is in addition to neutral conductor and in no case shall neutral conductor serve as grounding means.

3.2 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Continuity Test: Continuity test shall be performed on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

END OF SECTION 26 05 26

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SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section included hangers and supports for Power Systems, Communication Systems and Electronic Safety and Security Systems.
- B. Conduit Supports.
- C. Formed Steel Channel.
- D. Spring Steel Clips.
- E. Sleeves.
- F. Mechanical Sleeve Seals.
- G. Equipment Bases and Supports.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

1.3 REFERENCES

- A. International Building Code (IBC), Chapter 16 – Structural Design.

1.4 SUBMITTALS

- A. Division 01: Requirements for submittals.
- B. Product Data: Submit product data for specialty supports.

1.5 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.
- B. Perform Work in accordance with Municipality of Anchorage Standard Specifications.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Minerallac Fastening Systems.
 - 3. O-Z Gedney Co.
 - 4. Substitutions: per Division 01
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. self-locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. B-Line Systems.
 - 2. Allied Tube & Conduit Corp.
 - 3. Unistrut Corp.
 - 4. Substitutions: per Division 01.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

- A. Sleeves Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 MECHANICAL SLEEVE SEALS

- A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.

3.2 PREPARATION

- A. Obtain permission from Owner's Representative before using powder-actuated anchors.
- B. Obtain permission from Owner's Representative before drilling or cutting structural members.

3.3 INSTALLATION - GENERAL

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, preset inserts, beam clamps, or spring steel clips.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- C. Do not support raceways, low voltage pathways, cables, telecommunication pathways or boxes from ceiling suspension wires or suspended ceiling systems. Provide support from building structure independently to allow ceiling removal and replacement without removal of electrical system. If dedicated support wires are used, wires and wire clips must be painted or color-coded. Exception: Outlet boxes for ceiling-mounted light fixtures may be mounted in the ceiling system.
- D. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or ceiling suspension system.
- E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

- F. In wet locations install free-standing electrical equipment on concrete pads. Pad top shall be a minimum of 3 ½" above the surrounding grade and shall be reinforced in accordance with Division 3 of these specifications.
- G. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- H. Securely fasten fixtures and equipment to building structure in accordance with manufacturer's recommendations and to provide necessary earthquake anchorage.
- I. Provide wall attached fixtures and equipment weighing less than 50 pounds with backing plates of at least 1/8" x 10" sheet steel or 2" x 10" fire retardant treated wood securely built into the structural walls. Submit attachment details of heavier equipment for approval.
- J. Earthquake Anchorages:
 - 1. Equipment weighing more than 50 pounds shall be adequately anchored to the building structure to resist lateral earthquake forces.
 - 2. Total lateral (earthquake) forces shall be 1.5 times the equipment weight acting laterally in any direction through the equipment center of gravity. Provide adequate backing at structural attachment points to accept the forces involved.
- K. Provide one seismic support wire for all fixtures weighing less than 10lbs. two minimum color-coded dedicated seismic support wires for each ceiling mounted light fixture weighing less than 50 pounds. Attach support wires to building structure independent from ceiling system and on opposing corners of the light fixtures to not allow fixture to drop more than 6 inches upon ceiling failure. Secure each end with three tight wraps within 1 inch at each end of the wire. Provide four supports on fixtures >50 lbs.
- L. Attach the supporting cables for all pendant fixtures to both the building structure and to the ceiling grid which they pass through.
- M. Power-driven fasteners are prohibited for tension load applications (such as supporting luminaries or conduit racks from ceiling above). Use drilled-in expansion anchors, or drilled and screw-in anchors such as Kwik-Con II or Tapcon.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

END OF SECTION 26 05 29

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SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal Conduit.
- B. Flexible Metal Conduit.
- C. Liquidtight Metal Conduit.
- D. Fittings and Conduit Bodies.
- E. Pull and Junction Boxes.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 - General Requirements and Section 26 05 00 – Common Work Results for Electrical.
- B. Division 07 - Thermal and Moisture Protection.
- C. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- D. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- E. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- F. Section 26 05 53 – Identification for Electrical Systems.
- G. Section 26 27 26 – Wiring Devices.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 123 – Specification for Zinc Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.
- C. National Electrical Manufacturers Association (NEMA):

1. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - D. Underwriters Laboratory (UL):
 1. UL 6 - Rigid Steel Conduit, Zinc Coated.
 2. UL 514B – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - E. National Fire Protection Association (NFPA):
 1. NFPA 70 - National Electrical Code.
 - F. International Building Code (IBC):
 1. IBC chapters 16 and 17 seismic requirements.
- 1.4 RACEWAY AND BOX INSTALLATION SCHEDULE
- A. In or through CMU walls:
 1. Raceway: Provide rigid steel conduit or intermediate metal conduit. EMT conduit may penetrate through CMU walls where the EMT is installed in a sleeve and does not come in direct contact with the CMU. All conduit in contact with concrete or block shall be rigid steel conduit half lapped wrapped with pipe wrap or be plastic-coated conduit.
 2. Boxes and Enclosures: Provide concrete tight cast and sheet metal steel metal boxes.
 - B. Outdoor Above Grade, Damp or Wet Interior Locations:
 1. Raceway: Provide rigid steel conduit or intermediate metal conduit.
 2. Boxes and Enclosures: Provide weatherproof malleable iron for branch circuit junction and outlet boxes. Provide weatherproof NEMA 3R sheet metal enclosures for safety and disconnect switches and NEMA 4 sheet metal enclosures with gaskets for motor controllers and control panels.
 3. Fittings: Provide galvanized malleable iron with gaskets. Provide Myers threaded hubs for all conduit entries into top and side of sheet metal enclosures.
 - C. Concealed Dry Locations:
 1. Raceway: Provide rigid steel conduit, intermediate metal conduit, or electrical metallic tubing.
 2. Boxes and Enclosures: Provide sheet-metal boxes.
 3. Fittings: Provide galvanized malleable iron and steel.

D. Exposed Dry Locations:

1. Raceway: Provide rigid steel conduit or intermediate metal conduit. EMT conduit may be used where exposed conduit is allowed.
2. Boxes and Enclosures: Provide sheet-metal boxes with raised steel covers.
3. Fittings: Provide galvanized malleable iron and steel.

E. Branch Circuits 60 Amperes or Larger and Feeders:

1. Raceway: Provide rigid steel conduit or intermediate metal conduit.
2. Boxes and Enclosures: Provide sheet-metal boxes.
3. Fittings: Provide galvanized malleable iron and steel.

F. Hazardous Locations (Classified Wiring):

1. Raceway: Provide rigid steel conduit.
2. Boxes and Enclosures: Provide galvanized malleable iron rated Class 1 Division 1, NEMA FB1.

G. Equipment Connections: Provide short extensions (three feet maximum) of flexible metal conduit for connections to light fixtures, motors, transformers, vibrating equipment or equipment that requires removal for maintenance or replacement. Use Liquidtight flexible conduit and fittings for motors and equipment in damp or wet locations or subject to spilling of liquids as at pumps, kitchen equipment, in mechanical rooms, boiler rooms, pump rooms, etc.

1.5 DESIGN REQUIREMENTS

A. Raceway Minimum Size:

1. Below Grade: Provide 1 inch minimum, unless otherwise noted.
2. Above Grade or Slab on Grade: Provide 1/2 inch minimum, unless otherwise noted. Raceway may be reduced to 1/2 inch for final connection of raceway up to 6 feet for connection to fixture or device where maximum conduit entry size is 1/2 inch.
3. Line Voltage Circuits: Raceway is sized on the drawings for copper conductors with 600-Volt type XHHW insulation, unless otherwise noted. Where a raceway size is not shown on the drawings, it shall be calculated to not exceed the percentage fill specified in the NEC Table 1, Chapter 9 using the conduit dimensions of the NEC Table 4, Chapter 9 and conductor properties of the NEC Table 5, Chapter 9.

B. Box Minimum Size: Provide all boxes sized and configured per NEC Article 370 and as specified in this section.

C. Seismic Support: Provide support in accordance with section 26 05 29 – Hangers and Supports for Electrical Systems and 26 05 48 – Vibration and Seismic Support for Electrical Systems.

1.6 SUBMITTALS

- A. Product Data: Submit data for products to be provided.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC)

- A. Rigid Steel Conduit: ANSI C80.1, UL 6.
- B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; Galvanized malleable iron with threaded hubs for all conduit entries. Provide threaded connections and couplings only. Set Screw and running thread fittings are not permitted
- C. Provide insulated throat bushings at all conduit terminations.

2.2 PVC COATED RIGID METAL CONDUIT

- A. Product Description: NEMA RN 1; rigid steel conduit with external 40-mil PVC coating and 2-mil urethane internal surface.
- B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; steel fittings with insulated throat bushings and external PVC coating to match conduit.

2.3 INTERMEDIATE METAL CONDUIT (IMC)

- A. Product Description: ANSI C80.6, UL 1242; Galvanized Steel Conduit.
- B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; use fittings and conduit bodies specified above for rigid steel conduit.
- C. Provide insulated throat bushings at all conduit terminations.

2.4 FLEXIBLE METAL CONDUIT (FMC)

- A. Product Description: UL 1, FS WW-C-566; galvanized or zinc-coated flexible steel, full or reduced-wall thickness.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron with insulated throat bushings. Die cast zinc or threaded inside throat fittings are not acceptable.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Product Description: UL 360, flexible metal conduit with interlocked steel construction and PVC jacket.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; liquid tight steel or malleable iron with insulated throat bushings. Die cast fittings are not acceptable.

2.6 ELECTRICAL METALLIC TUBING (EMT)

- A. Product Description: ANSI C80.3, UL 797; galvanized steel tubing.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression or set screw type with insulated throat bushings. Zinc die cast, set screw, or indentor fittings are not acceptable.

2.7 RIGID NONMETALLIC CONDUIT (RNC)

- A. Not approved for use on this project.

2.8 HIGH DENSITY POLYETHYLENE CONDUIT (HDPE)

- A. Not approved for use on this project.

2.9 ELECTRICAL NONMETALLIC TUBING (ENT)

- A. Not approved for use on this project.

2.10 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, UL514A galvanized steel, with plaster ring where applicable.
 - 1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.
 - 2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required. Minimum Size: 4 inches square or octagonal, 2-1/8 inches deep.
 - 3. Concrete and Masonry: Concrete type with field installed tape cover to prevent concrete entry to raceway system. Minimum Size: 4 inches square, 2-1/8 inches deep.
- B. Cast Boxes: NEMA FB 1, Type FD, galvanized malleable iron. Furnish gasketed cover by box manufacturer. Furnish threaded hubs. “Bell” boxes are not acceptable.
- C. Wall Plates: As specified in Section 26 27 26.

2.11 PULL AND JUNCTION BOXES

- A. Sheet Metal Pull and Junction Boxes: ANSI/NEMA OS 1, UL514A galvanized steel.
 - 1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.
- B. Sheet Metal Boxes Larger Than 12 Inches in Any Dimension: Hinged enclosure in accordance with Section 26 27 16. Hoffman or approved equal.
- C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250, Type 4; flat-flanged, surface mounted junction box, UL listed as raintight:
 - 1. Material: Galvanized cast iron or copper-free cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover and screws.

2.12 EXPANSION FITTINGS

- A. Galvanized malleable iron, galvanized with grounding bond jumper.

2.13 RACEWAY SEALING FITTINGS

- A. Galvanized malleable iron, galvanized filled with sealing compound.
 - 1. Class 1 Division 1 boundary lines and isolation of arcing devices use Class 1 Division 1 sealing compound.

2.14 BUSHINGS

- A. Non-grounding: Threaded impact resistant plastic.
- B. Grounding: Insulated galvanized malleable iron/steel with hardened screw bond to raceway and conductor lug.

2.15 LOCKNUTS

- A. Threaded Electro Zinc Plated Steel designed to cut through protective coatings for ground continuity.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.

- B. Provide seismic support and fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes with origin and destination in accordance with Section 26 05 53.
- D. Unless otherwise noted, do not inter-mix conductors from separate panelboards or any other system in the same raceway system or junction boxes.

3.2 INSTALLATION - GENERAL RACEWAY

- A. Install raceway for all systems, unless otherwise noted.
- B. Install an equipment grounding conductor inside of all raceways containing line voltage conductors.
- C. Provide raceways concealed in construction unless specifically noted otherwise, or where installed at surface cabinets, motor and equipment connections and in Mechanical and Electrical Equipment rooms. Do not route conduits on roofs, outside of exterior walls, or along the surface of interior finished walls unless specifically noted on the plans.
- D. Raceway routing and boxes are shown in approximate locations unless dimensioned. Where raceway routing is not denoted, field-coordinate to provide complete wiring system.
- E. Do not route raceways on floor. Arrange raceway and boxes to maintain a minimum of 6 feet 6 inches of headroom and present a neat appearance. Install raceways level and square to a tolerance of 1/8" per 10 feet. Route exposed raceways and raceways above accessible ceilings parallel and perpendicular to walls, ceiling, and adjacent piping.
- F. Maintain minimum 6-inch clearance between raceway and mechanical and piping and ductwork. Maintain 12-inch clearance between raceway and heat sources such as flues, steam pipes, heating pipes, heating appliances, and other surfaces with temperatures exceeding 104 degrees F.
- G. Where raceway penetrates fire-rated walls and floors, provide mechanical fire-stop fittings with UL listed fire rating equal to wall or floor rating, seal opening around conduit with UL listed firestop sealant or intumescent firestop, preserving the fire time rating of the construction.
- H. Raceways and boxes penetrating vapor barriers or penetrating areas from cold to warm shall be taped and sealed with a non-hardening duct sealing compound to prevent the accumulation of moisture, and shall include a vapor barrier on the outside.
- I. Arrange raceway supports to prevent misalignment during wiring installation. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- J. Do not attach raceway to ceiling support wires or other piping systems and do not fasten raceway with wire or perforated pipe straps. Remove all wire used for temporary raceway support during construction, before conductors are pulled. Raceway shall be installed to permit ready removal of equipment, piping, ductwork, or ceiling tiles.

- K. Group raceway in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps, as specified in Section 26 05 29. Provide space on each rack for 25 percent additional raceway.
- L. Cut conduit square; de-burr cut ends. Bring conduit to the shoulder of fittings and couplings and fasten securely. Where locknuts are used, install with one inside box and one outside with dished part against box.
- M. Use threaded raintight conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations. Sealing locknuts are not acceptable.
- N. Install no more than the equivalent of three 90-degree bends between boxes.
- O. Install conduit bodies to make sharp changes in direction, such as around beams. "Goosenecks" in conduits are not acceptable.
- P. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.
- Q. Provide protective plastic bushings or insulated throat bushings at each raceway termination not installed to an enclosure. Bushings shall be threaded to the raceway end or connector.
- R. Avoid moisture traps; install junction box with drain fitting at low points in raceway system.
- S. Install fittings and flexible metal conduit to accommodate 3-axis movements where raceway crosses seismic joints.
- T. Install fittings designed and listed to accommodate expansion and contraction where raceway crosses control and expansion joints.
- U. Provide weatherhead on all raceway stub ups which are outdoors and do not terminate into equipment.
- V. Use cable sealing fittings forming a watertight non-slip connection to pass cords and cables into conduit. Size cable sealing fitting for the conductor outside diameter. Use Appleton CG series or equal cable sealing fittings.
- W. Use suitable caps to protect installed raceway against entrance of dirt and moisture.
- X. Provide nylon "jet-line" or approved equal pull string in empty raceway, except sleeves and nipples.
- Y. Paint all exposed conduit to match surface to which it is attached or crosses. Clean greasy or dirty conduit prior to painting in accordance with paint manufacturer's instructions. Where raceway penetrates non-rated ceilings, floors or walls, provide patching, paint and trim to retain architectural aesthetics similar to surroundings.

3.3 INSTALLATION – GENERAL BOXES

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance. All electrical box locations shown on Drawings are approximate unless dimensioned.
- B. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Where installation is inaccessible, install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaires. Coordinate locations and sizes of required access doors with Division 08.
- C. Coordinate layout and installation of boxes to provide adequate headroom and working clearance. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- D. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- E. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems and where normal and emergency power circuits occur in the same box.
- F. Verify location of floor boxes in offices and work areas prior to rough-in. Set boxes level and flush with finish flooring material.
- G. Adjust box location up to 6 feet prior to rough-in to accommodate intended purpose.
- H. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- I. Unless otherwise specifically noted, locate outlet boxes for light switches within 6 inches of the door jamb on the latch side of the door.
- J. Position outlets to locate luminaires as shown on reflected ceiling plans.
- K. Locate and install boxes to maintain headroom and to present a neat appearance.
- L. Locate flush-mounted box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- M. Provide knockout closures for unused openings.
- N. Install boxes in walls without damaging wall insulation or reducing its effectiveness.
- O. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. For outlet boxes in walls with combustible finished surfaces such as wood paneling or fabric wall coverings, position box to be flush with finished surface per NEC requirements.
- P. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes. Accurately position bridges to allow for surface finish thickness.

- Q. Do not install flush mounted boxes back-to-back in walls; install with minimum 6 inches separation.
- R. Install with minimum 24 inches separation in fire rated walls. Limit penetrations in fire rated walls to 16 square inches each and a maximum total combined penetration area of 100 square inches in any given 100 square feet of wall. Where penetrations are in excess of these requirements provided UL listed fire stop wrap acceptable to Authority having Jurisdiction.
- S. Do not fasten boxes to ceiling support wires or other piping systems.
- T. Support boxes independently of conduit.
- U. Clean interior of boxes to remove dust, debris, and other material and clean exposed surfaces and restore finish.
- V. Provide blank covers or plates for all boxes that do not contain devices.

END OF SECTION 26 05 33

SECTION 26 05 48 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section includes requirements for vibration and seismic restraints for electrical equipment installed in seismic categories C, D, E or F.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- C. Section 26 05 29 – Hangers and Supports for Electrical Systems.

1.3 DESCRIPTION

- A. Provide seismic anchorage and restraint of electrical systems including, equipment, raceways, cable trays, lighting fixtures, etc.
- B. Seismic Category D, E and F:
 - 1. All electrical items that are of Importance Factor (I_p) = 1.5 are required to be seismically braced. This applies to the following:
 - a. The component is required to function for life safety purposes after an earthquake, including fire protection systems, fire alarm systems, emergency lighting, etc.
 - b. The component contains hazardous materials.
 - c. The component is in or attached to an Occupancy Category IV structure (Hospitals, fire station, police station, emergency shelters, etc. per ASCE 7-05, Table 1-1) and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
- C. All other electrical equipment shall be assigned a component importance factor (I_p) = 1.0 and are required to be seismically braced unless one of the following conditions is satisfied:
 - 1. Component is MOUNTED (connection to structure) at less than 4' above the floor (to the center of gravity of the component), and weighs less than 400 lbs.

2. Component is mounted higher than 4' (to the center of gravity of the component), but weighs less than 50 lbs (if it is concealed).
 3. Component is mounted higher than 4' (to the center of gravity of the component), but weighs less than 100 lbs (if it is exposed).
 4. Flexible connections between the components and associated conduit are provided.
 5. All runs or groupings of conduits on or off of trapezes shall be seismically braced, unless the distribution system (including conduit, wiring and fittings) weighs less than 5 pounds per linear foot.
 6. Lighting fixtures, lighted signs and ceiling fans that are not rigidly connected to ducts or piping, that are supported by chains or otherwise suspended from structure, are not required to be seismically braced, as long as:
 - a. The attachment points can carry at least 140% of the weight of the fixture, and
 - b. The swinging light will not create a falling debris problem by bumping into ceiling of other finishes, and
 - c. Connections to structure allow for movement of the fixture without damaging the connections.
- D. In accordance with ASCE 7-10 13.6.4, all electrical components with $I_p = 1.5$ shall also satisfy the following requirements:
1. Provisions shall be made to eliminate seismic impact between components.
 2. Loads imposed on the components by attached utility or service lines that are attached to separate structures shall be evaluated.
 3. Batteries on racks shall have wrap-around restraints to ensure that the batteries will not fall from the rack. Spacers shall be used between restraints and cells to prevent damage to cases. Racks shall be evaluated for sufficient lateral load capacity.
 4. Internal coils of dry type transformers shall be positively attached to their supporting substructure within the transformer enclosure.
 5. Electrical control panels, computer equipment, and other items with slide-out components shall have a latching mechanism to hold the components in place.
 6. Electrical cabinet design shall comply with the applicable National Electrical Manufacturers Association (NEMA) standards. Cutouts in the lower shear panel that have not been made by the manufacturer and reduce significantly the strength of the cabinet shall be specifically evaluated.
 7. The attachments of additional external items weighing more than 100 lbs shall be specifically evaluated if not provided by the manufacturer.

- 8. Where conduit, cable trays, or similar electrical distribution components are attached to structures that could displace relative to one another and for isolated structures where such components cross the isolation interface, the components shall be designed to accommodate the seismic relative displacements defined in ASCE 7-10 Section 13.3.2.
- E. Unless otherwise exempted above, electrical component supports and the means by which they are attached to the component shall be designed for the Seismic Category they are installed in accordance with ASCE 7-10 Section 13.6.5.

1.4 REFERENCE STANDARDS

- A. Seismic anchorage and restraints shall be designed and installed in accordance with codes and standards as enforced by authorities having jurisdiction in Kenai, Alaska. Authorities shall include Owner's insurance company.
- B. Where applicable, building standards supersede those of other evaluation or listing agencies referenced in specification.
- C. International Building Code (IBC), Chapter 16 – Structural Design.
- D. ASCE 7-10 Chapter 13.

1.5 SUBMITTALS

- A. Provide structurally engineered shop drawings for seismic restraint of all electrical equipment required by the International Building Code (IBC), Chapters 16, 17. Structural design shall be based on the Seismic Use Category and Seismic Design Category as designated in these chapters.
- B. Provide complete calculations, drawings and details.
- C. Shop drawings shall be stamped by a professional engineer registered in the State of Alaska.
- D. Submittals shall be coordinated with building Structural engineer.
- E. Submit for approval, seismic restraint calculations, drawings and details to authorities having jurisdiction as required by those authorities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials and devices shall be in accordance with applicable codes and standards and shall be appropriate for intended use.
- B. Anchors and attachments to building structure shall be as approved by building Structural engineer.

- C. Seismic restraints used in conjunction with vibration isolators may consist of loose cables, telescoping pipes or box sections, angles or sections, flat plates used as limit stops or snubbers, or other types of housing used either integral with or separate from vibration isolators to accomplish necessary seismic restraint.

2.2 EQUIPMENT

- A. Equipment available with seismic rating shall be provided with rating applicable to seismic zone of project location.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Secure stationary equipment, raceways and equipment supports to structure, concrete bases, or special supports to provide protection against earthquakes and to restrain lateral or vertical movement. Where vibration isolators are used, seismic restraints shall be designed to limit lateral or vertical movement during earthquake without short-circuiting vibration isolation system.
- B. Coordinate seismic restraints with building Structural engineer and incorporate building Structural engineer's requirements.
- C. Seismic restraint methods and materials shall be supplementary to support devices specified in other sections of this specification and together shall serve as equipment support criteria.
- D. Installation of devices shall be in accordance with seismic Structural engineer's drawings and details and in accordance with seismic guidelines.
- E. Coordinate installation of devices with other trades and incorporate their requirements.
- F. Modify raceway and equipment locations as required for seismic restraint system.
- G. Seismic restraint systems shall not interfere with installation of other building systems or access.

END OF SECTION 26 05 48

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and Tape Labels.
- B. Wire and Cable Markers.
- C. Wire Markers.
- D. Working Clearance Striping.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- D. Section 26 24 16 – Panelboards.
- E. Section 26 27 26 – Wiring Devices.

1.3 SUBMITTALS

- A. Division 01 and Section 26 05 00 – Common Work Results for Electrical.
- B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color-coding, tag number, location, and function.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved white letters on black background. Nameplate for service disconnect shall be engraved white letters on red background.
- B. Letter Size:
 - 1. 1/4-inch high letters for identifying individual panel or equipment.
 - 2. 1/8-inch high letters for remaining lines with 1/8 inch spacing between lines.
- C. Minimum nameplate size: 1/8 inch thick with a consistent length and height for each type of nameplate wherever installed on the project.

2.2 TAPE LABELS

- A. Product Description: Adhesive tape labels, with 3/16 inch Bold Black letters on clear background made using Dymo Rhino series label printer or approved equal.
- B. Embossed adhesive tape will not be permitted for any application.

2.3 WIRE MARKERS

- A. Power and Lighting Description: Machine printed heat-shrink tubing, cloth or wrap-on type, for all neutrals and Phase conductors.

2.4 WORKING CLEARANCE STRIPING

- A. Product description: 2" wide epoxy yellow paint with 2 inch high block letters within the clearance area to read: "ELECTRICAL CLEARANCE – NO STORAGE WITHIN THIS ZONE".

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Degrease and clean surfaces to receive nameplates and tape labels.
- B. Install nameplates and tape labels parallel to equipment lines.

3.2 NAMEPLATE INSTALLATION

- A. Secure nameplates to equipment fronts using machine screws tapped and threaded into panelboard, or using rivets. The use of adhesives is not acceptable. Machine screws to not protrude more than 1/16 inch on back side.
- B. Service Disconnect Nameplate: Provide nameplate on exterior service disconnect that reads “SERVICE DISCONNECT”.
- C. Distribution Panel Nameplates:
 - 1. Provide overall equipment identification.
 - a. Line 1: Distribution panel name.
 - b. Line 2: Source which panelboard is fed.
 - c. Line 3: Voltage, phase and wire configuration.
 - d. Line 4: AIC rating of the panel.
 - e. Line 5: Where applicable, indicate that panel is series-rated.
 - 2. Provide circuit breaker identification for each feeder breaker.
 - a. Line 1: Name of panelboard or equipment served.
 - b. Line 2: Location of served panelboard.
- D. Disconnects, Starters, or Contactors:
 - 1. Provide nameplate for each device with the following information:
 - a. Line 1: Load served.
 - b. Line 2: Panelboard and circuit number from which the device is fed.
 - c. Line 3: Fuse or Circuit amperage and poles. Where fused disconnect is installed, denote the maximum fuse size to be installed.

3.3 LABEL INSTALLATION

- A. Conduit Feeder Labels - Provide conduit labels on all feeder raceways as follows:
 - 1. Distribution Panels – “PANEL xxxx IN ROOM #xxx”.
 - 2. Panelboards – “PANEL xxxx FED FROM MDP xxx”.
- B. Spare Raceways: Provide raceway label on each individual raceway denoting the source and termination point at each end.

3.4 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identification shall be as follows:
 - 1. Markers shall be located within one inch of each cable end, except at panelboards, where markers for branch circuit conductors shall be visible without removing panel deadfront.
 - 2. Each wire and cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations.
 - 3. Color code phases, neutral, and ground per NEC requirements and Section 26 05 19.
 - 4. Color-code all low-voltage system wires and cables in accordance with the individual sections in which they are specified.
 - 5. For power and lighting circuits, identify with branch circuit or feeder number.
 - 6. Control Circuits: Control wire number as indicated on schematic and shop drawings.
- B. Provide pull string markers at each end of all pull strings. Marker shall identify the location of the opposite end of the pull string.

3.5 JUNCTION BOX IDENTIFICATION

- A. Fire Alarm: In accessible ceiling spaces, exposed ceiling spaces, mechanical/electrical rooms, and other non-public spaces, paint fire alarm junction boxes and pullboxes with red spray paint. In all finished spaces where fire alarm boxes are visible, they shall be painted to match the surrounding finish. If there are any questions as to whether fire alarm boxes shall be painted red in a specific area, the Contractor shall get clarification from the Owner prior to painting.
- B. Label each lighting and power junction box with the panelboard name and circuit number.
- C. For junction boxes above ceilings, mark the box cover with the circuit or system designation using permanent black marker. For junction boxes in finished areas, mark the inside of the cover with the circuit or system designation using permanent black marker.

3.6 DEVICE PLATE IDENTIFICATION

- A. Label each receptacle device plate or point of connection denoting the panelboard name and circuit number.
- B. Install adhesive label on the top of each plate.

3.7 PANELBOARD IDENTIFICATION

- A. Provide panelboard circuit directories in accordance with Section 26 24 16.

3.8 LOW-VOLTAGE SYSTEM IDENTIFICATION

- A. Install all labeling in accordance with the requirements of this section and of each section where the individual systems are specified.

3.9 WORKING CLEARANCE STRIPING

- A. Working clearance striping paint shall be applied in front of panels located in mechanical rooms, electrical rooms, storage rooms, and other non-public areas with exposed concrete floors.
- B. Striping paint shall not be applied in front of panels located in corridors and other public spaces, or spaces with finished floor surfaces (e.g., carpet, tile, vinyl, etc.).

END OF SECTION 26 05 53

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SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Lighting and Appliance Branch Circuit Panelboards.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- C. Section 26 05 53 – Identification for Electrical Systems.
- D. Section 26 05 48 – Vibration and Seismic Control for Electrical Systems.

1.3 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers.
- B. NEMA PB 1 - Panelboards.
- C. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- D. UL 50 – Enclosures for Electrical Equipment.
- E. UL 67 – Panelboards.
- F. Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit and Service.

1.4 SUBMITTALS

- A. Submit data under provisions of Division 01 and Section 26 05 00.
- B. Product Data: Submit product data for all components provided which fall under this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Submit final record panel schedules as hardcopy and in Microsoft Excel format. Submit under Section 26 05 00.
- B. Operation and Maintenance Manuals: Provide product data and shop drawing information including replacement parts list. Provide installation, operation and maintenance information per manufacturer.
- C. Panel Schedules: Prior to Substantial Completion, submit copies of all panel schedules for review by the Owner. The Owner will note any changes to the room numbers/names and the Contractor shall provide revised typed panel schedules to reflect all changes, at no additional cost to the Owner.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Division 01.
- B. Upon arrival at the site inspect equipment and report on any damage.
- C. Handle carefully on site to avoid any damage to internal components, enclosures and finishes.
- D. Store in a clean, dry environment. Maintain factory packaging and provide an additional heavy canvas or plastic cover to protect enclosures from dirt, water, construction debris and traffic.

1.7 WARRANTY

- A. Manufacturer shall warrant specified equipment to be free of defects for a period of one year from the date of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - PANELBOARDS

- A. Square D.
- B. Cutler Hammer.
- C. General Electric.
- D. Siemens.
- E. Substitutions: Under provisions of Division 01.

2.2 PANELBOARD LOAD CENTER IDENTIFICATION

- A. For each panelboard and each existing panelboard where circuits are added or modified, provide typed schedule denoting each circuit load by the load type and final name and room number actually in use in the facility. Schedule shall not be typed with names shown on the Contract Drawings unless names are acceptable to the Owner.
- B. Provide panel schedule in O&M manual for every new panelboard and every existing panelboard where circuits are added or modified.
- C. Where more than one nominal voltage system is present on the premises, the conductor color-coding legend shall be permanently posted at each branch circuit and distribution panelboard per NEC requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install new breaker(s) in existing panel(s) and test for proper operation. Update circuit directory to reflect all changes.
- B. Provide filler plates for unused spaces in panelboards.

3.2 FIELD QUALITY CONTROL

- A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall Switches.
- B. Receptacles.
- C. Device Plates and Box Covers.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 - General Requirements and Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- D. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 – Federal Specification for Electrical Power Connector, Plug, Receptacle, and Cable Outlet.
- B. FS W-S-896 – Federal Specification for Switches, Toggle (Toggle and Lock), Flush Mounted.
- C. NEMA WD 1 - General Color Requirements for Wiring Devices.
- D. ANSI/NEMA WD 6 – Wiring Devices – Dimensional Requirement.
- E. UL 20 – General-Use Snap Switches.
- F. UL 943 – Ground-Fault-Circuit-Interrupters.

1.4 SUBMITTALS

- A. Product Data: Submit product data for all components provided that are specified in this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - WALL SWITCHES

- A. Hubbell.
- B. Leviton.
- C. Pass & Seymour.
- D. Arrow Hart
- E. Substitutions: Under provisions of Division 01.

2.2 WALL SWITCHES

- A. Wall Switches for Lighting Circuits: UL 20; ANSI/NEMA WD-6; and Federal Specification FS W-S-896 AC industrial grade snap switch with toggle handle, rated 20 amperes and 120-277 volts AC. Handle: White nylon. Provide single-pole, 3-way, or 4-way switches as indicated on Plans.

2.3 ACCEPTABLE MANUFACTURERS - WALL DIMMERS

- A. Lutron.
- B. Leviton.
- C. Substitutions: Under provisions of Division 01.

2.4 ACCEPTABLE MANUFACTURERS - RECEPTACLES

- A. Hubbell.
- B. Leviton.
- C. Pass & Seymour.
- D. Arrow Hart
- E. Substitutions: Under provisions of Division 01.

2.5 RECEPTACLES

- A. Convenience and Straight-blade Receptacles: UL 498, ANSI/NEMA WD-6 and Federal Specification FS W-C-596 industrial grade receptacle.
- B. Convenience Receptacle Configuration: ANSI/NEMA WD-6; Type 5-20R, white nylon face.

- C. GFCI Receptacles: ANSI/NEMA WD-6; 20A, duplex convenience receptacle with integral class 'A' ground fault current interrupter, LED indicator lamp and integral lockout.

2.6 DEVICE PLATES

- A. Decorative Cover Plate: Smooth 430 or 302 stainless steel with metal, counter sunk screws to match device plate.
- B. Exposed Work Cover Plate: ½ inch raised, square, pressed, galvanized or cadmium plated steel cover plate supporting devices independent of the outlet box.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wall switches 48 inches above floor, OFF position down.
- B. Unless otherwise noted install wall switches within 6 inches of the door jamb on the strike side.
- C. Install convenience receptacles 18 inches above floor, 4 inches above counters or backsplash, grounding pole on bottom.
- D. Unless otherwise noted, mounting heights are for finished floor to center line of outlet.
- E. Install decorative plates on switch, receptacle, and blank outlets in finished areas. Use midsize or jumbo plates for outlets installed in masonry walls, where required to cover up imperfections in the wall opening.
- F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- G. Install devices and wall plates flush and level.
- H. Ground receptacles to boxes with a grounding wire. Grounding through the yoke or screw contact is not an acceptable alternate to the ground wire.

END OF SECTION 26 27 26

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Magnetic Motor Starters.
- B. Combination Magnetic Motor Starters.

1.2 RELATED SECTIONS

- A. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC).
- B. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.
- C. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCES

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.
- B. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- C. NEMA AB 1 - Molded Case Circuit Breakers.
- D. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 01.
- B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include recommended maintenance procedures and intervals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - MOTOR STARTERS

- A. Square D.
- B. Allen Bradley.
- C. Siemens.
- D. Cutler Hammer.
- E. Substitutions: Under provisions of Division 01.

2.2 MANUAL MOTOR STARTERS

- A. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, number of poles as required by the load served, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle operator.
- B. Enclosure: ANSI/NEMA ICS 6; Type 1, 3R or 4. As indicated on the Drawings.

2.3 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Full Voltage Starting: Non-reversing type.
- C. Coil Operating Voltage: 120 volts, 60 Hertz.
- D. Size: NEMA ICS 2; size as required by the load served.
- E. Overload Relay: NEMA ICS 2; bimetal.
- F. Enclosure: NEMA ICS 6; Type 1 or 3R as shown on the drawings.
- G. Combination Motor Starters: Combine motor starters with motor circuit protector disconnect in common enclosure.
- H. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts in addition to seal-in contact.
- I. Indicating Lights: NEMA ICS 2; RUN: red LED light in front cover.
- J. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.
- K. Control Power Transformers: 120 volt secondary, VA capacity as required by the load served in each motor starter.

- L. Power Monitor: Include a three-phase power monitor in each magnetic starter connected to shut down the motor on loss of any phase, phase reversal, or low voltage on any phase. Power monitor shall automatically reset and restart motor when phase and voltage conditions return to normal. Provide oversize starter enclosures as required to install power monitor.

2.4 CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS

- A. Motor Circuit Protector: NEMA AB 1; circuit breakers with integral instantaneous magnetic trip in each pole.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motor control equipment in accordance with manufacturer's instructions.
- B. Select and install heater elements in motor starters to match installed motor characteristics.
- C. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.
- D. After final connections are made, check and correct the rotation of all motors.
- E. Field adjust the trip settings of all motor starter magnetic trip only circuit breakers to approximately 11 times motor full load current. Determine full load current from motor nameplate following installation.

END OF SECTION 26 29 13

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SECTION 26 50 00 – LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior and Exterior Luminaires and Accessories.
- B. Lamp Modules.
- C. Drivers.
- D. Exit Signs and Emergency Lighting Units

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements, and Section 26 05 00 – Common Work Results for Electrical.
- B. Division 09 – Finishes: Painting and Ceilings.
- C. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- E. Section 26 05 29 - Hangers and Supports for Electrical Systems: General Supports for Luminaires.
- F. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- G. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems: Seismic Supports for Luminaires.
- H. Section 26 05 53 – Identification for Electrical Systems.
- I. Section 26 27 26 – Wiring Devices.

1.3 DEFINITIONS

- A. CCT: Correlated Color Temperature.
- B. CRI: Color Rendering Index.
- C. Driver: LED Power Supply.
- D. Fixture: See "Luminaire."

- E. IES: Illuminating Engineering Society of North America
- F. IP: International Protection or Ingress Protection Rating.
- G. Lamp Module: Replaceable LED board array/light engine including a plug-in connector.
- H. LED: Light-emitting diode.
- I. Lumen: Measured output of lamp and luminaire, or both.
- J. Luminaire: Complete lighting unit, including lamp or lamp module, driver, reflector, and housing.
- K. THD: Total Harmonic Distortion.

1.4 REFERENCE STANDARDS

- A. NECA/IESNA 500 – Recommended Practice for Installation Indoor Commercial Lighting System.
- B. IES TM-21-11 Projecting Long Term Lumen Maintenance of LED Light Sources.
- C. IES LM-80 IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.
- D. UL 924 - Emergency Lighting and Power Equipment.

1.5 SUBMITTALS

- A. Product Data: Submit the following:
 - 1. Luminaires: Include manufacturer's product data sheets and/or shop drawings including outline drawings showing support points, weights, and accessory information for each luminaire type. Clearly indicate all options being provided. Arrange data for luminaires in the order of fixture designation.
 - 2. Prior to preparing submittals, coordinate with the reflected ceiling plan for ceiling finishes and provide all necessary kits, brackets, stems, trim, etc. to install the specified fixtures in the ceilings provided. Clearly note these configurations on the product data sheets.
- B. Shop Drawings: Provide detailed shop drawings for specialty luminaires as required by the manufacturer.
- C. Warranty: Provide copies of manufacturer's warranty information for each luminaire. If warranty information is the same for a group of manufacturer's luminaires, provide a letter or schedule clearly indicating what warranty applies to each fixture.
- D. LED Luminaire Substitutions: Due to the constantly evolving technology, it is difficult to evaluate a true "equal" LED luminaire since the wattage, LED life, lumen output, etc. vary

significantly from fixture to fixture, even for luminaires that have a similar shape and style. The luminaires shown on the Plans in the Fixture Schedule are not intended to be sole sourced but are considered a Basis of Design. If a substitution is proposed by the contractor, it will be evaluated based on the following criteria:

1. Does it have the same basic shape/style and characteristics? Note that there may be space constraints above the ceiling.
2. Does the luminaire have the same (or superior) light output and distribution? If not, would it still produce enough light to illuminate the space per minimum IES recommendations or other project specific lighting levels? Note that the Engineer may request .ies files or lighting calculations be provided by the Contractor to evaluate substitution requests.
3. Does it use the same (or less) wattage than the specified fixture? If it uses slightly more power, does it provide enough value to the Owner by adding additional light to offset the additional power used? Is that appropriate for the project compliance requirements. (LEED, ASHRAE 90.1, etc.)
4. Does it have an equal or better lamp life as calculated in accordance with IES TM-21 and LM-80?
5. Does the manufacturer offer an equal or better warranty than the specified fixture?
6. Are the LED lamps modules and LED boards field changeable? What guarantees does the manufacturer have that replacement parts will be available in the future?

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Indicate actual locations and mounting heights of all lighting fixtures and accessories on the project record drawings. Update part numbers and description on the Lighting Fixture Schedule to match the actual luminaires installed. Submit under Section 26 05 00.
- B. Operation and Maintenance Manuals:
 1. Provide recommended luminaire cleaning and re-lamping schedule. If any luminaire lenses require special lubricants for cleaning, include this in the schedule.
 2. Provide detailed bill of materials for all items purchased in this section including distributor's contact name, phone number and pertinent information.
 3. Provide luminaire manufacturer's installation instructions.
 4. Provide manufacturer's step-by-step installation instructions showing how to replace the LED lamp modules and drivers for each luminaire.
 5. Include any specific warranty information provided by the manufacturer for luminaires, LED boards and drivers.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect in a clean, dry environment under provisions of General Conditions of the Contract.

1.8 EXTRA MATERIALS

- A. Provide spare parts under provisions of Division 01.
- B. Lenses: One of each size and type.
- C. Drivers: One of each size and type installed.
- D. LED Lamp Modules: Provide a minimum of 2 of each unique type of lamp module used on the project. Ship LED lamp modules (i.e. LED board) in protective packaging and label each lamp module to indicate the fixture type that it may be installed in. (i.e. Type A or Type D1).
- E. LED Luminaire: Where the specified or substitute luminaire does not have a replaceable lamp or lamp module, provide one spare luminaire per size and type installed.

PART 2 - PRODUCTS

2.1 INTERIOR AND EXTERIOR LUMINAIRES AND ACCESSORIES

- A. Luminaires: Provide UL listed luminaires as scheduled on the drawings or as approved equal.
- B. Listing: Luminaires shall be listed for use in the environment in which they are installed. For example, luminaires installed in return air plenums, direct contact with insulation, or in hazardous, wet, damp, or corrosive locations shall be UL listed for such application.
- C. Accessories: Provide all mounting kits, supports, interconnecting wiring, power supplies, trim kits, gaskets, etc. for a complete installation.
- D. Housing:
 - 1. Metal parts shall be free of burrs and sharp corners and edges. Form and support to prevent warping and sagging.
 - 2. Doors, Frames and Other Internal Access: Smooth operating, free of light leakage under operating conditions. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
 - 3. Luminaires shall be factory painted and free of discoloration. Color as scheduled.

2.2 LAMP MODULES – LED

- A. All LED's shall be nominal 4000 degrees Kelvin (nominal) within a 3-step MacAdam Ellipse unless special circumstances require a different color temperature application, see Luminaire Schedule on Plans.
- B. Color Rendering: Minimum CRI as scheduled on the Plans for each fixture. Under no circumstances shall the CRI be less than 70.
- C. Lamp Life: Minimum lamp life shall be calculated in accordance with IES LM-80. Lamp life for each luminaire shall be equal or greater than scheduled on the Plans. Under no circumstances shall an interior luminaire have a minimum rated life (L70) less than 50,000 hours at 75 degrees F average indoor ambient temperature and an outdoor luminaire less than 75,000 hours at 40 degrees F average outdoor ambient temperature.
- D. Replaceable: Unless otherwise scheduled, all LED modules shall be field replaceable with quick disconnect connections.

2.3 DRIVERS - LED

- A. LED Driver: Provide UL listed power supply as recommended by the LED fixture manufacturer for operation of the specified LED lamps. Power supply shall be integral to the luminaire unless otherwise noted on the Plans. Power supply shall be dual voltage (120/277V) where available or operate at the supply voltage indicated on the Plans.
- B. LED Dimming Driver: UL listed 0-10V dimming driver as recommended by the LED fixture manufacturer for operation of the specified LED lamps, fully compatible with the dimming system or dimming switch controlling the fixture. Driver shall be integral to the fixture and capable of dimming the luminaire down to 1% output unless otherwise scheduled on the Plans. Power supply shall be dual voltage (120/277V) where available and operate at the supply voltage indicated on the Plans.

2.4 EXIT SIGNS AND EMERGENCY LIGHTING UNITS

- A. Luminaires: Provide UL listed exit signs and emergency lighting units as scheduled on the drawings or as approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction items that penetrate ceilings or are supported by them, including luminaires, occupancy sensors, HVAC equipment, smoke detectors, fire-suppression system, IP video cameras, and partition assemblies. Adjust locations as required.
- B. Unless otherwise noted on Plans, provide drivers integral to luminaires, pre-wired and installed at the factory, suitable for use with the selected LED lamps.

- C. Support surface-mounted luminaires directly from building structure. Install level and parallel/perpendicular with ceiling or wall surfaces.
- D. Support luminaires in suspended ceilings from structure above in accordance with Section 26 05 29.
- E. Rigidly align continuous rows of lighting fixtures for true in-line appearance.
- F. Provide luminaire disconnecting means in the wiring compartment of each luminaire. Where the luminaire is fed from a multi-wire branch circuit, provide multi-pole disconnect to simultaneously break all supply conductors to the ballast, including the grounded conductor.
- G. LED Power Supplies: Install power supplies to be readily accessible. Where power supplies are installed in plenum areas, provide plenum rated listing. Where remote power supplies are used, install in concealed, accessible locations or in utility room that provides adequate sound dampening. Locate driver to allow free air movement in accordance with manufacturer's installation instructions and securely mount to structure.
- H. Aim directional lampheads of emergency lighting units to illuminate the path of egress.
- I. Install emergency driver {or single fixture emergency transfer device} in the driver channel of the fixtures or the mounting tray of downlight fixtures indicated on the drawings. Provide an unswitched source of power to the emergency driver from the same circuit that powers the fixture the driver is installed in.
- J. Coordinate location of wall mounted emergency lighting units with mechanical equipment, ductwork, piping, or any other obstruction that would impact the lighting output.
- K. Wiring installed between a luminaire and an emergency lighting inverter or remote emergency driver is considered "emergency" wiring and shall be separated from the normal wiring and installed in a dedicated raceway per NEC Article 700.

3.2 RELAMPING

- A. Re-lamp or replace luminaires that have failed lamps at completion of work.

3.3 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Touch up luminaire finish at completion of work.

3.4 FIELD QUALITY CONTROL

- A. Tests: Perform tests listed below according to manufacturer's written instructions. Test unit functions, operations, and protective features. Adjust to ensure operation complies with Specifications. Perform tests required by NFPA 70, Articles 700 and 701. Perform tests on

completion of unit installation and after building circuits have been energized. Provide instruments to permit accurate observation of tests. Include the following tests:

1. Simulate power outage: Verify proper operation of each individual emergency power supply.
 2. Verify emergency supply duration.
 3. Verify operation of remote test switches.
 4. Provide reports for load test conducted on individual batteries.
- B. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.5 ADJUSTING

- A. Aim lamps on wall-mounted emergency lighting units to obtain the following illumination of egress pathway:
1. An average of 1 foot-candle.
 2. A minimum at any point of 0.1 foot-candle measured along the path of egress at floor level.
 3. Maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.
- B. Test emergency lighting equipment in accordance with the manufacturer's instructions and NECA/IESNA 500.

3.6 DEMONSTRATION

- A. Walk owner's representative through the emergency lighting system. Note how to maintain, test and troubleshoot all units. Provide maintenance schedule for NFPA required testing and note locations of remote test switches, and which units have self-diagnostic features.

END OF SECTION 26 50 00

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DIVISION 40

PROCESS INTERCONNECTIONS

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SECTION 40 05 01 - PROCESS PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, and test the process piping systems and appurtenances, complete and functional, as specified herein and as shown on the Drawings.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. 01 10 00 – Summary
- C. 01 33 00 – Submittal Procedures
- D. 05 12 00 – Structural Steel Framing
- E. 09 90 10 – Painting and Coatings for Process Equipment
- F. 40 05 50 – Process Valves and Operators
- G. 43 23 00 – Process Pumps

1.3 QUALITY ASSURANCE/REFERENCES

- A. Piping and appurtenances shall, as applicable, meet the requirements of the most recent version of the following industry publications, standards, regulations, and requirements as may be referenced in this Section and the Contract Documents:
 - 1. American Iron and Steel Institute (AISI)
 - 2. American National Standards Institute (ANSI)
 - a. B16.1 Gray Iron Pipe Flanges and Flanged Fittings
 - b. B16.5 Pipe Flanges and Flanged Fittings: NPS ½-inch through 24-inch
 - c. B31.3 Process Piping
 - 3. American Society of Mechanical Engineers (ASME)
 - a. B31.3 Process Piping, ASME Code for Pressure Piping
 - 4. American Society for Testing and Materials (ASTM)

5. American Water Works Association (AWWA)
 6. American Welding Society (AWS)
 - a. A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination
 - b. A5.1 Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
 - c. B2.1 Specification for Welding Procedure and Performance Qualification
 - d. D1.1 Structural Welding Code, Steel
 - e. D1.6 Structural Welding Code Stainless Steel
 - f. QC1 Standard for AWS Certification of Welding Inspectors
 7. ANSI/Manufacturers' Standardization Society (MSS). Standard Practice (SP).
 - a. SP-58 Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
 - b. SP-69 Pipe Hangers and Supports - Selection and Application
 - c. SP-89 Pipe Hangers and Supports - Fabrication and Installation Practices
 - d. SP-127 Bracing for Piping Systems: Seismic-Wind-Dynamic Design, Selection, and Application
 8. International Building Code (IBC) Seismic loading and bracing as amended by the City of Kenai.
 9. Uniform Plumbing Code (UPC) as amended and adopted by the State of Alaska
- B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1 Structural Welding Code Steel.
 2. AWS D1.6 Structural Welding Code Stainless Steel
 3. AWS D10.4 Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing
 4. ASME Boiler and Pressure Vessel Code: Section IX
 5. API 1104 Welding of Pipelines and Related Facilities

1.4 SUBMITTALS

- A. Prepare, deliver, and process under provisions of Section 01 33 00 SUBMITTAL PROCEDURES. Requests for proposed substitute or "or-equal" equipment/systems/products will be considered in accordance with Section 01 25 00 SUBSTITUTION PROCEDURES.

- B. Complete list of all deviations from the Drawings and Specifications.
- C. Shop Drawings. Provide the following:
 - 1. Field Verifications
 - a. Verify materials and construction of existing piping which will either be modified or joined to the new piping installed as part of the Work.
 - 2. For all pipes to be used in the work, provide pipe manufacturer's product information including:
 - a. Dimensional data. Show wall thickness of steel cylinder and fittings.
 - b. Material of construction, with ASTM reference and grade. Submit manufacturer's certificates of compliance with referenced pipe standards.
 - c. Performance data: pressure ratings, temperature limitations, and chemical compatibility.
 - 3. Schedule of piping.
 - 4. Type, and methods of interconnections of pipe to existing piping, pipe valves and fittings, equipment, vents, and drains as applicable.
 - 5. Piping layout drawings showing the location and dimensions of the pipe and fittings. Include layout lengths of valves, meters, pumps, pipe supports and other equipment determining piping dimensions. Label or number each fitting or piece of pipe. Show:
 - a. Centerline dimensioning of piping from column lines and/or face of walls.
 - b. Centerline dimensioning and indication of elevation of ductwork, conduit, or other interfering item or object which may require coordination.
 - 6. Shop Fabricated Piping. Where piping systems are fabricated in a location other than the Project site, submit shop drawings for pre-fabricated piping systems including:
 - a. Pipe fabrication and spool drawings.
 - b. Fittings layout, and location of each pipe length.
 - c. Installation sequence.
 - 7. Gasket manufacturer's product data for flange and coupling gaskets.
 - 8. Revisions to interior piping and pipe support drawings as required.
 - 9. Qualifications of pipe supplier for plant-applied linings and coatings.
 - 10. Special shipping, storage, protection and handling instructions.

D. Welding Procedures and Qualifications. Provide the following:

1. Certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.
2. Welding procedure specification and the results of the procedure qualification test records for each type of welding which requires procedure qualification and the welder, welding operator, or tacker qualification test records. Welding procedures which are considered prequalified as specified in ANSI/AWS D1.1 will be accepted without further qualification.

E. Quality Control. Provide the following:

1. Certification of welder qualifications in accordance with ANSI B31.3, Paragraph 328.2 for shop and project site welding of process pipe work.
2. Pipe, fittings, and appurtenances:
 - a. Confirmation of product(s) compliance with specified standards.
 - b. Manufacturer's Certification of Compliance.
3. Pipe supports: Manufacturer's Certification of Compliance.
4. Pipe leakage testing.
 - a. Testing plan and methods.
 - b. Certifications of Calibration: Testing equipment.
 - c. Certified pipe test reports.
5. Field welding inspection and testing report.
6. Operation and Maintenance Manuals: Include:
 - a. Manufacturers recommended spare parts and special tools.
 - b. Maintenance schedule showing the required maintenance, frequency of maintenance, and other items required at each regular preventative maintenance period.

F. Deferred Submittals for Support of Pipe Systems. Provide the following:

1. Design and prepare submittals for proposed methods of piping system support.
2. Design of pipe support systems to meet the requirements of this section and of the structural sections of the projects' Contract Documents.

1.5 SUPPORT SYSTEMS - DESIGN REQUIREMENTS

- A. Provide pipe hangers or supports, and bracing as shown on the Drawings, otherwise use appropriate type of support as approved through the SUBMITTALS process.
- B. Where pipe support details are not provided in the Drawings, CONTRACTOR to retain its own resources to design and submit pipe support systems through the project submittal process.
 1. CONTRACTOR shall obtain the services of a registered structural professional engineer for design of the supports for any CONTRACTOR-revised drawing support details, or proposed support systems, or as otherwise required to provide code compliant pipe support.
 2. Seismic anchorage and bracing systems shall be designed, signed and stamped by a qualified professional engineer registered in the State of Alaska, unless the system design is specifically provided within the Contract Documents.
 3. Loading and bracing shall be in accordance with the International Building Code (IBC) as amended and adopted by the State of Alaska and the City of Kenai, and per the requirements detailed on the Structural Drawings and specifications.
 4. Support Load: Dead loads imposed by weight of pipes filled with water, except air pipes, including valves and appurtenances, plus pipe support system infrastructure. Safety Factor: Minimum of 5.
 5. Pipe, valve, and process components and elements permanently attached to the structure shall be designed to transfer the component seismic forces specified in ASCE 7-10, Section 13.3.1 to the structure.
- C. Exposed Pipe Support Systems:
 1. Maximum Support Spacing and Minimum Rod Size: Per the pipe manufacturer's recommendations, or as indicated below, or as otherwise detailed on the Drawings.

Pipe Material	Nominal Size	Spacing of Supports
Steel, Galvanized Steel, and Stainless Steel	1" and smaller	5 feet
	1-1/4" to 2"	7 feet
	Larger than 2"	10 feet
Copper	1" and smaller	5 feet
	1-1/4" and larger	8 feet
PVC/CPVC	1" and smaller	4 feet
	1-1/4" to 2"	4-1/2 feet
	2-1/2" to 3-1/2"	5 feet
	4" to 5"	6 feet
Ductile Iron	6" and larger	7 feet
	All sizes	8 feet
	Less than 3"	8 feet
Fiberglass	3" and larger	10 feet

2. Other Pipes and Special Situations: May require supplementary hangers and supports.

- D. Sway Bracing: As required by the IBC or indicated on structural drawings.
- E. Anchoring Devices: Design, size, and space support anchoring devices, including concrete piers, anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.
- F. Existing Support Systems: CONTRACTOR may reuse existing support systems as proven adequate for new pipe installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
- B. Gaskets: Store gaskets in cool, dry, well-ventilated area with no exposure to direct sunlight. Do not allow gasket contact with petroleum products (oil, fuel, and solvents).
- C. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
- D. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
- E. Linings and coatings: Protect from damage by heat and excessive drying.
- F. Store equipment in clean, dry, well-ventilated area. Protect materials from freezing and provide heated storage areas as recommended by the equipment fabricator.
- G. Handling: Use heavy canvas or nylon slings to lift pipe and fittings. Handling and/or lifting of glass lined pipe and fittings must be done on the exterior only. Avoid lifting internally with hooks, forks or chains at any time.

1.7 PRE-INSTALLATION MEETING

- A. Prior to starting work under this section on site, CONTRACTOR shall conduct a pre-installation meeting with the OWNER and treatment plant Operators. As a minimum, discuss the work to be performed, the sequence of activities, coordination of work with other trades and the Owner and treatment plant Operators, and testing and reporting procedures as applicable.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Seismic Restraint, Load and Design: Per the requirements detailed on the Structural Drawings.
- B. CONTRACTOR shall be responsible for modification of appurtenant equipment and piping to accommodate selected equipment. CONTRACTOR shall notify OWNER of modifications necessary to accommodate selected equipment and shall submit for review and approval the proposed modifications.

- C. The Contract Documents indicate specific required features of the equipment, but do not purport to cover all details of design and construction.

2.2 PIPING

- A. See PIPING SCHEDULE included at the end of this specification.
- B. Piping and appurtenances specified herein per referenced standards shall meet the requirements of the most recent version of said standards.
- C. Piping and appurtenances shall be in accordance with the provisions of the most current version of the Uniform Plumbing Code (UPC) as amended and adopted by the State of Alaska.
- D. CONTRACTOR shall be responsible for modification of appurtenant equipment and piping to accommodate selected equipment. CONTRACTOR shall notify OWNER of modifications necessary to accommodate selected equipment and shall submit for review and approval the proposed modifications.
- E. CEMENT LINED DUCTILE IRON (DI)
 - 1. Service: Exposed, Sludge
 - 2. Flanged Pipe
 - a. Pipe Barrel: AWWA C151/ANSI A21.51.
 - b. Threaded Flanged Pipe. AWWA C115/ANSI A21.15; thickness Class 53 minimum. Ductile iron flat face flange per ASME B16.1 drilling and facing Class 125. Pipe barrel and flange taper pipe thread (NPT) per ANSI B1.20.1. Flanged pipe rated at 250 psi. Working pressure: <100 psi.
 - c. Interior Lining for pipe and fittings: AWWA/ANSI C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings. ASTM, Type II, with seal coat.
 - d. Exterior Coating: AWWA/ANSI C151/A21.50 standard asphaltic.
 - 3. Fittings
 - a. Fittings shall have the same lining, coating and the same or higher pressure rating as the pipe.
 - b. All Elbows shall be short radius, unless noted otherwise. Provide tapped connection(s) on fittings as shown on the Drawings.
 - c. Provide factory fabricated tapped connection for fittings where shown on the Drawings.
 - d. Flanged:
 - 1) Flanged fittings: ANSI/AWWA C110/A21.10
 - 2) Flanges: ANSI/ASME B16.1 125-pound or 150-pound flat face.

- 3) Gaskets: 1/8-inch thick styrene butadiene rubber (SBR) or (poly)chloroprene rubber (CR), full face.
- 4) Bolts, Nuts and Washers: ASTM F593, Group 1 stainless steel hex head bolts and ASTM F594 hex head nuts. Washers shall be the same material as the bolts.
- 5) Where shown or required, blind flanges coupled with companion flanges, and/or flanged spool pieces shall be gasketed covering the entire inside face with the gasket cemented to the blind flange.

F. CHLORINATED (CPVC) and POLYVINYL CHLORIDE (PVC)

1. Service:
 - a. Exposed, Cold Non-Potable Water
 - b. Exposed, Tempered Non-Potable Water
 - c. Exposed, Polymer
2. CPVC
 - a. Pipe shall conform to ASTM F441, Schedule 80; and ASTM D1784, Type IV, Grade 1. Cell classification 23447B.
 - b. Fittings: Schedule 80, Series 150. ASTM F437, threaded. ASTM F439, socket.
3. PVC
 - a. Pipe shall conform to ASTM D1785, Schedule 80; and ASTM D1784, Type 1, Grade 1. Cell classification 12454B.
 - b. Fittings: Schedule 80. ASTM D2464, threaded. ASTM D2467, socket.
4. Flanges: One piece molded hub type matching adjoining pipe (CPVC or PVC), Flat Face conforming to the physical properties of the fittings, faced and drilled per ANSI B16.5, Class 150.
5. Gaskets: 1/8-inch thick
 - a. Viton for systems carrying chemical solution
 - b. Styrene butadiene rubber (SBR) or (poly)chloroprene rubber (CR) for systems carrying water (NPW)
6. Joints: Solvent socket weld. Threaded or flanged joints shall be provided at unions, valves and equipment as required.
7. Seals/O-rings: EPDM
8. Bolts, Nuts, Washers: 316L stainless steel bolts ASTM F593 and ASTM F594 hex head nuts. Washers shall be the same material as the nuts and bolts.

G. STAINLESS STEEL (SST)

1. Service:
 - a. Exposed, ¾-inch High Pressure Air.
 - b. Digested Sludge discharge at sludge pressure instrument flushing ring.
 - c. Non-potable water flushing water supply piping at sludge pressure instrument flushing ring.
2. Pipe:
 - a. 6-inch and smaller: ASTM A312, Type 316L, Schedule 40, seamless annealed, pickled and passivated. Butt-weld or cut-groove end joint.
3. Tubing:
 - a. 1/2 inch and smaller: ASTM A269, Type 316L Seamless Stainless Steel Tube. Manufacturer and Product: Swagelok Company, Stainless Steel Seamless Tubing and fittings.
4. All mounting nipples for gauges, instruments and other appurtenances shall be Type 316, Schedule 80, conforming to ASTM A 312.
5. Threaded Fittings:
 - a. ASTM A182, Type 304L, Schedule 40. Conforming to ASME B16.11 and ASME B1.20.2 threads.
 - b. Lubricant/Sealant: PTFE pipe-thread tape per ASTM D3308.
6. Welding Fittings:
 - a. Forgings, weld neck flanges, etc.: ASTM A182, F304.
 - b. Butt welded fittings: ASTM A403, Type 304L.
 - c. Backing Rings: Crane, Cat. No. 45B.
7. Slip on Flanges: Stainless Steel, 150 lb, ASTM A182 F304/L, Grade B, flat face.
8. Bolts, Nuts and Washers: Bolts shall be Type 316 stainless steel, ASTM F593, Group 2, oval neck track head. Nuts shall be Type 316 stainless steel, F594, Group 2, heavy hex. Washers shall be the same material as bolts.
9. Gaskets: Gaskets shall be full face, 1/8-inch thick, white neoprene or Buna-N.
 - a. Manufacturer and Product: Prince Rubber & Plastic Co., Inc., Panacea, PT70-M, PTFE protected EPDM gasket. Or approved equal.
10. Welding Electrodes: AWS 5.9, ER 308L.

H. Copper (CU)

1. Seamless, ASTM B88.
2. Water, Buried: Type K, soft or hard tempered.
3. Water, Exposed: Type L, hard drawn.
4. Fittings. Wrought copper, socket joint, per ASTM B75 and ANSI B16.22.
5. Flanges: 150-pound, cast copper alloy flanges and flanged fittings shall be in accordance with ANSI/ASME B 16.24 and ASTM B 62.
6. Bolts, Nuts and Washers: ASTM F2329 Hot dip zinc coated.
 - a. ASTM 307 Grade A hex head bolts.
 - b. ASTM A563 Grade A hex head nuts. Washers shall be the same material as the bolts.
7. Gaskets: 1/16-inch thick non-asbestos compression type, full face.
8. Solder. 95-5 wire solder per ASTM B32 (95% tin, 5% antimony).

2.3 RUPTURE DISK

- A. Service: Digested Sludge Pumps discharge over-pressure relief, 45 – 115 °F
1. Forward Acting Composite. 316 stainless steel, Teflon seal, compressed fiber gaskets.
 2. Burst Pressure Setting: 50 psig
 3. Mounted between Class 125 ductile iron flat face flanges, ASME B16.1
- B. Manufacturer and Product: Zook, ARD Series, Disk Type ARD-L. Or approved equal.

2.4 WYE STRAINERS

- A. Service: Cold Water, 40 – 60 °F, 75 psi
1. Wye pattern, 0.8 mm stainless steel screen. CPVC Schedule 80 (Cell class 23447 per ASTM D1784) body and cap. NPT true union ends, and blow-off port. FPM seals.
- B. Manufacturer and Product: Hayward Flow Control, YS Series Y-Strainers. Or approved equal.

2.5 RUBBER HOSE

- A. Service: Nonpotable Water (W2) Wash Down Hose and Nozzles

- B. Provide 25-feet of hose per hose reel. Ends with couplings to match nozzle and angle supply valve.
- C. 3/4-inch rubber tube with spiral-ply fabric reinforcement and rubber cover. Working pressure rating: 150 psi. Temperature rating: -40 to 190 °F. Manufacturer and Product: GoodYear Rubber Products, Sureline®. Or approved equal.
- D. Nozzle: 3/4-inch brass, on/off flow and adjustable flow and pattern with body rotation. Manufacturer and Product: Guardian Fire Equipment, Inc., Industrial Nozzle Model No. 3722. Or approved equal.

2.6 CHEMICAL HOSE

- 1. Service: Chemical Hose for discharge of Owner's barrel pump to transfer neat polymer from 55 gallon polybarrels to T-5-1
- 2. Wetted Material: Crossed link polyethylene
- 3. Nominal size: 1-inch
- 4. ID 1.0 inches, OD 1.47 inches
- 5. Length: 12 feet
- 6. Minimum bend radius 8 inches
- 7. Working Pressure rating 150 psi
- 8. Temperature range -25 to 150 deg F
- 9. End connections: King nipple x Threaded stainless steel MNTP, band connection to hose at King nipple
- 10. Manufacturer and Model: Continental Hose Green XLPE Cross Link Polyethylene hose

2.7 SUPPORT SYSTEMS

A. General

- 1. Provide pipe hangers, supports, and/or bracing as shown on the Drawings and specified herein, otherwise design, furnish and install support system infrastructure as approved through the SUBMITTALS process.
- 2. Supports shall be used to meet all criteria herein, regardless of whether or not indicated on the Drawings. No pipe shall be left unsupported whenever a change in direction of line or flow takes place. At least one support shall be provided between every two couplings. Supports shall be provided for all valves, meters, or other metallic appurtenances.
- 3. Securely fasten all piping and pipe support systems to building infrastructure with approved iron hangers, supports, guides, anchors and sway braces to maintain pipe

alignment and prevent sagging, noise and excessive strain due to uncontrolled movement under operating conditions. Add structural support system infrastructure as needed to supplement locations of pipe support.

4. Pipe system support may be provided in part by
 - a. Existing building framing upgraded as needed for that service
 - b. New building framing where the added load of the pipe system does not overload those structural elements
 - c. Systems mounted directly to the floor of the new or existing building structures
 - d. Tanks and/or catwalk infrastructure where use of those elements is approved by the equipment suppliers and project structural designers
 - e. New additional structural members integrated into other project infrastructure that enables compliance with pipe support requirements of these project contract documents.
5. Piping support systems are to be configured so as not to impede access to treatment equipment or block passage of equipment into or out of the buildings as may be needed for future maintenance and/or replacement efforts.
6. Relocate any hangers as necessary to correct unsatisfactory conditions that may become evident when system is put into operation.
7. Fasten hanger rods to structural steel members with suitable beam clamps.
8. Protect pipe insulation at every hanger, support or guide of insulated piping with inserts and shields.
9. Where supported by pipe hangers from the ceiling or where lateral displacement of pipe is probable, pipelines shall be seismically braced laterally at every 20 feet, and braced longitudinally and laterally every 40 feet and at all 90-degree bends. The seismic bracing shall consist of 3/8-inch steel plate welded to pipe hanger, 1/2-inch diameter all threaded rod, 1/2-inch diameter flexible connector and eye rod inserted in the ceiling.
10. Support piping connections to equipment by pipe support, not the equipment.
11. Support no pipe from the pipe above it.
12. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
13. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
14. Do not install pipe supports and hangers in equipment access areas.
15. Repair mounting surfaces to original condition.

B. Support Materials:

1. Wetted and Submerged: Type 316 stainless steel, unless otherwise noted on the Drawings or in the specifications.
2. Atmospheric Exposed at finished floor and up to 6-feet above finished floor: Hot dipped galvanized channel steel strut system (not electroplated-galvanized).
3. Atmospheric Exposed at greater than 6-feet above finished floor: Hot dipped galvanized channel steel strut system (not electroplated-galvanized).
4. Channel-type Pipe Supports
 - a. Hot Dipped Galvanized Steel Strut System. Hot Dipped Galvanized conforming to ASTM A 123 or A 153
 - 1) Channel Sections:
 - a) Dimensions: 1½”x1½”; 12 gauge Steel
 - b) Steel: ASTM A1011 SS GR 33
 - c) Unistrut P1000 HG
 - 2) Channel End Caps/Frame Caps:
 - a) Plastic White. Compatible with Channel section.
 - 3) Fasteners:
 - a) Materials: 316 Stainless Steel ASTM A240
 - b) Threads: UNC
 - c) Unistrut Hex Head Cap Screws
 - d) Unistrut Channel Nuts with Springs
 - e) Unistrut Machine Screw/Washer and Hex Nut Assemblies
 - 4) Fittings:
 - a) ASTM A1011 SS GR 33
 - b) ASTM A575, A576, A635, or A36
 - c) Unistrut P2626 HG
 - d) Unistrut P1062 HG
 - 5) Pipe Hangers, Clamps, and Support:
 - a) ASTM A1011 SS GR 33
 - b) ASTM A575, A576, A635, or A36
 - c) Unistrut product HG, suitable for service
 - 6) Cushioned Pipe Clamps:
 - a) Stainless Steel
 - b) Cushion: thermoplastice elastomer.
 - c) Unistrut Cush-a-Clamp® assembly.
Service: Polymer piping support

C. Hangers:

1. Adjustable clevis: MSS SP-69 (Type 1).
 - a. Manufacturers and Products: Anvil; Figure 260.
2. Adjustable swivel ring, hinged split-ring: MSS SP-69 (Type 6).

- a. Manufacturers and Products: Anvil; Figure 104.
 - 3. Beam Clamp: MSS SP 69, Type 23; and clamp restraint:
 - a. Manufacturers and Products: Anvil; Figure 86; and Figure 89X.
 - 4. Pipe Clamp: Alloy steel for suspension of high temperature pipe. MSS-SP-69 (Type 2); and forged steel weldless eye nut, right hand thread.
 - a. Manufacturers and Products: Anvil; Figure 224; and Figure 290.
 - D. Riser Clamp: MSS SP 58, Type 8.
 - 1. Manufacturer and Product: Anvil; Figure 261.
 - E. Anchor chair with U-bolt strap.
 - 1. Manufacturers and Product: Anvil; Figure 103.
 - F. Pipe saddle support with or without U-bolt; or pedestal type with schedule 40 pipe stanchion, anchoring companion flange and saddle.
 - 1. Manufacturers and Products: Anvil; Figure 258 and 259; Figure 264 (adjustable).
 - G. Stanchion, long radius elbow support.
 - 1. Manufacturers and Products: Anvil; Figure 62, Type A.
 - H. Welded Steel Wall Bracket, MSS-SP-69 (Type 32 or 33)
 - 1. Manufacturers and Products: Anvil; Figure 195 or 199.
 - I. Pipe Strap: ½-inch through 4-inch; MSS-SP-69 (Type 26), galvanized.
 - 1. Manufacturers and Products: Anvil; Figure 262.
- 2.8 ACCESSORIES
- A. Vibration Isolation Pads, Neoprene Pads:
 - 1. Type: Neoprene Waffle.
 - 2. Manufacturers and Product:
 - a. Mason Industries, Inc., Anaheim, CA; Type W.
 - b. Korfund Dynamics (VMC), Bloomingdale, NJ; Korpad.
 - B. Dielectric Isolation:
 - 1. All metallic piping shall be dielectrically isolated from piping or other materials constructed from dissimilar metals, as required of the work.

2. Flange dielectric insulation sets shall contain full faced gaskets, full-length sleeves, and double insulating washers, or as otherwise specified.
 - a. Insulation material for the flange insulation sets shall be phenolic resin and flange faced gaskets shall be neoprene faced phenolic resin. The manufacturer shall designate insulating materials suitable for the operating pressure.
3. Union dielectric insulation sets shall be rated at 250 psi, confined O-ring seal, brass ring complying with ASTM A105, confined gasket, forged steel nut and body, nylon insulation, threading per ANSI B2.1. Manufacturer: EPCO or Central Plastics.

2.9 PIPE INSULATION

- A. Service: Indoors, (W2)
- B. Furnish and install insulation on all surfaces of process piping designated.
- C. Closed cell-type, elastomeric foam tube insulation, ASTM C534 Type 1. Thickness: 1-½-inch
 1. Thermal Conductivity: 0.27 BTU-in/hr-ft²-°F, ASTM C177 or C518.
 2. Water Vapor Permeability: 0.08 perm-inch, ASTM E96.
 3. Mold Growth: UL 181.
 4. Water Absorption: 0.2 % by volume, ASTM C209.
 5. Adhesive and Seam Sealant: Per manufacturer's recommendation.
- D. Manufacturer and Products: AP Armaflex Tube, white. Adhesive: Armaflex 520. Or Approved Equal.

2.10 IDENTIFICATION LABELS

- A. Pipe Labels and Flow Direction Arrows
- B. Material: Manufacture from or encase in outdoor grade plastic or vinyl that will resist damage or fading from wash down, sunlight, mildly corrosive atmosphere, dirt, grease, and abrasion.
- C. Message: See Piping Schedule.
- D. Label, Lettering Size, and Color: ANSI A13.1.
 1. Snap-Around Type: Size for finished outside diameter of pipe and insulation.
 2. For 6-inch and larger diameter pipe: May furnish strap-on type fastened without use of tools, with plastic or Type 316 stainless steel straps.
 3. Firmly grip pipe so labels remain fixed in vertical pipe runs.
- E. Manufacturers and Products:

1. Seton Identification Products, Branford, CT; Setmark Pipe Markers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify size, structure penetrations, material, joint types, elevation, horizontal location, and pipe service to be connected to pipelines and equipment.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in undamaged condition, in Manufacturer's original container or packaging, with identifying labels intact and legible.
- B. Handle and store products in accordance with the Manufacturer's instructions.
- C. Ropes, fabric, or rubber-protected slings shall be used to handle pipe.
- D. Pipe shall be handled in such a manner that it not be dragged over sharp or cutting objects.

3.3 PREPARATION

- A. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.
- B. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

3.4 INSTALLATION-GENERAL

- A. Join pipe and fittings in accordance with manufacturer's instructions, unless noted otherwise.
- B. Flanged Joints:
 1. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline, aligned with connecting equipment flanges, or as shown. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.
 2. Lubricate bolts prior to installation.
 3. Use torque-limiting wrenches to ensure proper bearing and bolt tightness.
 4. Plastic Flanges:
 - a. Install annular ring filler gasket at joints of raised-face flange.
 - b. Use Van Stone flanges for thermoplastic flanged connections.

5. Use flat-face flange when joining with flat-faced ductile or cast iron flanges.
6. Where raised face flanges are encountered in the work, notify OWNER. Approval may be required for removal of raised face on the flange and use of full face gasket may be required when connecting to flat-faced ductile or cast iron flanges.

C. Threaded and Coupled Joints:

1. Conform to ANSI B1.20.1.
2. Ream, clean, and remove burrs from threaded piping before making up joints. Apply thread lubricant to threaded ends before installing fittings, couplings, unions, or joints.
3. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
4. Counter-sink pipe ends, ream and clean chips and burrs after threading.
5. Make connections with not more than three threads exposed.

3.5 INSTALLATION-EXPOSED PIPING

A. Route piping:

1. To conserve building space and avoid interference with other work and use of space
2. Beneath elevated grating system as much as possible as this provides minimal tripping hazards for the process area.
3. To enable easy access to valves and instrumentation by operations and maintenance personnel.

3.6 SUPPORT SYSTEMS - INSTALLATION

A. General:

1. Install support systems in accordance with manufacturer's recommendations.
2. Support piping connections to equipment by pipe support and not by the equipment. Do not support pipe from pumps to which it is connected. Support no pipe from the pipe above it.
3. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
4. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
5. Do not install pipe supports and hangers in equipment access areas.
6. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.

7. Install lateral supports for seismic loads at all changes in direction.
8. Repair mounting surfaces to original condition.

B. Accessories:

1. Vibration Isolation Pad: Provide neoprene waffle isolation pad under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.
2. Dielectric Barrier:
 - a. Install between carbon steel members and copper or stainless steel pipe.
 - b. Install between stainless steel supports and non-stainless steel ferrous metal piping.

3.7 CLEANING

- A. Following assembly and prior to testing, and as required for final acceptance, flush pipelines with water at a minimum of 2.5 foot per second to flush out debris.

3.8 PRESSURE LEAKAGE TESTING

A. PREPARATION

1. Piping shall be flushed or cleaned as appropriate prior to testing of this section.
2. Do not perform pneumatic testing on CPVC, PVC or HDPE piping.
3. Pressure Piping:
 - a. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
 - b. Prior to test, remove or isolate equipment that could be damaged by test and isolate equipment that may interfere with test.
 - c. Test Pressure: As indicated on Piping Schedule

B. QUALITY ASSURANCE

1. Flow meters shall record the actual volume plus or minus 2 percent.
2. Air test gauges shall be ANSI/ASME B40.1, Grade 3A (plus or minus 0.25 percent of full scale accuracy), 15 psi dial range.
3. Water test gauges shall be ANSI/ASME B40.1, Grade 2A (plus or minus 0.5 percent of full scale accuracy), dial range approximately twice the required test pressure.

C. HYDROSTATIC TEST FOR PRESSURE PIPING

1. Fluid: Water.

2. Test Pressure: Per Piping Schedule
3. Exposed Piping:
 - a. Perform testing on installed piping prior to application of insulation.
 - b. Maximum Filling Velocity: 0.25 feet per second, applied over full area of pipe.
 - c. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
 - d. Maintain hydrostatic test pressure for 30-minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
 - e. Examine joints and connections for leakage. Correct visible leakage and retest.

D. FIELD QUALITY CONTROL

1. Test Report:
 - a. Provide records of each piping installation during the testing. These records shall include:
 - b. Date of Test.
 - c. Identification of pipeline, or pipeline section, tested or retested.
 - d. Identification of pipeline material.
 - e. Identification of pipe specification.
 - f. Test fluid.
 - g. Test pressure.
 - h. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
2. CONTRACTOR shall sign to represent that specified testing has been completed.

3.9 FIELD FINISHING

- A. Coat atmospheric exposed surfaces of black, hot-dip galvanized steel components and other designated pipes and piping systems as required in specification Section 09 90 10 Painting and Coatings for Process Equipment.
- B. Exterior Coating, all sizes of new Ductile Iron Pipe and Fittings and appurtenances, and including pipe, valves, and appurtenances provided with Manufacturer's factory-finished exterior coating.
 1. Exposed Metal in Corrosive Environment.

- a. In particular to ductile iron pipe (DI) with no asphaltic coating, and existing DI with existing coatings; pipe shall be cleaned and surface prepared per NAPF 500-03 to receive factory high-solids epoxy primer and/or field coatings.

Surface Prep.	Coating	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10)	Polyamide Epoxy Primer	1 coat, 3 MDFT
DIP: NAPF-500-03-04. Detergent Wash, Fresh Water Rinse, brush blast if primer is aged, and in Accordance with the Manufacturer's Directions (as required)	Polyamide Epoxy	2 coats, 4 MDFTPC

3.10 IDENTIFICATION LABELS

A. Pipe Labels and Flow Indication Arrows:

1. Apply to indoor piping.
2. Locate at equipment connections, valves, wall and floor boundaries.
3. At 10-feet on center with at least one label applied to each exposed horizontal and vertical run of pipe.
4. At exposed piping not normally in view, such as in cabinets.
5. Installation: In accordance with manufacturer's instructions.

3.11 RECORD DRAWINGS

- A. CONTRACTOR shall maintain a current set of construction drawings and specifications that reflect any changes, modifications, clarifications, additions, or deletions from the Contract Documents per specification Section 01 78 39 PROJECT RECORD DOCUMENTS. Annotations shall include any CONTRACTOR issued equipment or wiring identification tags and/or numbers. Record drawing information shall be provided to the OWNER at the completion of system start up and substantial completion.

3.12 FINAL CLEAN

- A. Clean surfaces in accordance with Manufacturer's written instructions.

SECTION 40 05 01 - PROCESS PIPING

3.13 PIPING SCHEDULE

Legend	Service	Size(s) (Inch)	Location	Piping Material	Pressure, test (psig)	Remarks
D	Drain	1-8	Exposed	CPVC/PVC	maximum static	
DS	Digested Sludge	3, 4	Exposed	DI	100	
CA	Compressed Air	$\frac{3}{4}$	Exposed	SST	100	
W2	Non-Potable Water	$\frac{1}{2}$ - 4	Exposed	CPVC/PVC	100	insulated
W2	Non-Potable Water	1 - 4	Exposed	Copper	100	insulated
HW1	Hot Potable Water	$\frac{3}{4}$	Exposed	Copper	100	insulated
HW2	Hot Non-Potable Water	$\frac{1}{2}$ - 2	Exposed	Copper	100	insulated
TW2	Tempered Non-Potable Water	$\frac{1}{2}$ - 2	Exposed	Copper	100	insulated
TW2	Tempered Non-Potable Water	$\frac{1}{2}$ - 2	Exposed	CPVC/PVC	100	insulated
OF	Overflow	1-3	Exposed	CPVC/PVC	maximum static	
POLY	Polymer Solution	$\frac{1}{2}$, 1, 1 $\frac{1}{2}$, 2	Exposed	CPVC/PVC	100	

END OF SECTION 40 05 01

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SECTION 40 05 50 – PROCESS VALVES AND OPERATORS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, and verify the function of valves, operators, and appurtenances, complete and functional, as described in this specification and as shown on the Drawings.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. 01 10 00 – Summary
- C. 01 33 00 – Submittal Procedures
- D. 01 60 00 – Product Requirements
- E. 01 75 00 – Starting and Adjusting
- F. 40 05 01 – Process Piping
- G. 40 90 00 – Process Control and Instrumentation Systems
- H. 43 23 00 – Process Pumps

1.3 QUALITY ASSURANCE/REFERENCES

- A. Valves, operators, and appurtenances shall, as applicable, meet the requirements of the most recent version of the following industry publications, standards, regulations, and requirements as may be referenced in this Section and the Contract Documents:
- B. American Society for Testing and Materials (ASTM)
 - 1. A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting
 - 2. A276, Standard Specification Stainless Steel Bars and Shapes
 - 3. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- C. American Society of Mechanical Engineers (ASME)
 - 1. ASME PCC-1-2013, Guidelines for Pressure Boundary Bolted Flange Joint Assembly

- D. American National Standards Institute (ANSI)/ASME
 - 1. ANSI/ASME B31.3, Process Piping
- E. ANSI/American Water Works Association (AWWA) Standards; current editions:
 - 1. C550 Protective Interior Coatings for Valves and Hydrants
 - 2. C509 Gate Valves
 - 3. C517 Eccentric Plug Valves
 - 4. C542 Electric Valve Actuators
- F. Manufacturers' Standardization Society (MSS)
 - 1. SP-72, Ball Valves with Flanged or Butt-Welding Ends for General Service
 - 2. SP-110, Ball Valves; Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
- G. International Building Code (IBC) Seismic loading and bracing as amended by the City of Kenai.
- H. Uniform Plumbing Code (UPC) as amended and adopted by the State of Alaska

1.4 SUBMITTALS

- A. Prepare, deliver, and process under provisions of Section 01 33 00 SUBMITTAL PROCEDURES. Requests for proposed substitute or "or-equal" equipment/systems/products will be considered in accordance with Section 01 25 00 SUBSTITUTION PROCEDURES.
- B. Complete list of all deviations from the Drawings and Specifications.
- C. Shop Drawings. Provide the following:
 - 1. Documentation of field measurements, elevations, and inverts used to prepare and verify shop drawings prior to drawing release.
 - 2. Product data and cut sheets for manufacturer and model of all equipment and components intended for use in the work, and an itemized list of such.
 - 3. Complete catalog information, descriptive literature, specifications, and identification of materials of construction, including headloss characteristics, operating torque, and operational requirements of each valve, operator and/or actuator.
 - 4. Seismic anchorage, support, and bracing calculations and details stamped and sealed by a Professional Engineer registered in the state of Alaska.
 - 5. For all valves and operator assemblies:
 - a. Dimensional information on scale drawing(s) of valve and actuator

- b. Materials of construction; Coatings as applicable
 - c. Applicable valve tag or identification number(s)
 - d. Nominal size, Weight, and End Connections
 - e. Operating pressure and temperature ratings, and associated pressure class standards.
 - f. Intended service
 - 1) Quarter turn, Multi-turn, Linear
 - 2) Open/Close or Modulating
 - 3) Process Fluid(s)
 - g. Stem operating configuration
 - 1) Rising, non-rising as applicable
 - h. Headloss Characteristics
 - 1) Flow coefficient Cv or Kv values: for valve fully open, and for at least three valve positions between 15 to 90 percent open.
6. For manual valve operators:
- a. Type: Lever or Hand wheel,
 - 1) Gear Drive Mechanism
 - a) Worm Gear, Scotch Yoke, Overhead Chain Wheel Operator
 - b) Below Footing Extended Operator Stem and/or Valve Key
 - b. Dimensional information on scaled drawing(s)
 - c. Torque required for dynamic operations and seating against maximum differential head conditions.
 - d. Number of turns to open/close for multi-turn valves.
7. For electrically actuated valves:
- a. Electrical power requirements including amperage for jammed valve condition
 - b. Rated available torque
 - c. Electrical enclosure NEMA rating
 - d. Housing materials of construction and coating system
 - e. Internal heater rating and power requirements
 - f. Limit switch type and number of each
 - g. Valve position monitoring and local/remote reporting mechanism(s)
 - h. De-clutching mechanism for manual hand wheel override valve actuation

- i. Means of providing visual indication of valve position
- D. Quality Control. Provide the following:
 - 1. Functional test and results of performance confirmation checks per specification Section 01 75 00 STARTING AND ADJUSTING and required by this specification.
 - 2. Operation and Maintenance Manuals per the requirements of Section 01 33 00, paragraph *Operation and Maintenance Manuals*, and include:
 - a. Manufacturer's recommended spare parts and special tools.
 - b. Recommended operating and repair procedures
 - c. Maintenance schedule showing the required maintenance, frequency of maintenance, lubricants, and other items required at each regular preventative maintenance period.

1.5 ELECTRICAL

- A. Third Party Listings
 - 1. ALL equipment, systems, assemblies, controls and instrumentation, electrical drivers, and appurtenant electrical components MUST be third party listed and labeled per the regulations of the State of Alaska. Third party listings include Underwriters Laboratories, or others suitable to the State of Alaska. Use listed materials in the work according to the criteria for these listings.
- B. Code Conformance
 - 1. All work will be configured and assembled in accordance with applicable electrical codes observed in the United States and Alaska at the time the equipment is fabricated. Codes that apply include the National Electric Code, the National Electrical Contractors' Association Standards, and other codes may apply as appropriate to the Work.

PART 2 - PRODUCTS

2.1 GENERAL

- A. New Materials: All materials furnished for this Work shall be new and unused elsewhere. No recycled materials and/or re-built formerly used equipment or materials shall be allowed.
- B. Seismic Restraint, Load and Design: Per the requirements detailed on the Structural Drawings and specifications, including requirements of specification Section 40 05 01 PROCESS PIPING SUPPORT SYSTEMS – DESIGN REQUIREMENTS.
- C. Backflow prevention devices shall be installed in piping systems where shown in the Drawings and/or as required by the Alaska Department of Environmental Conservation, and shall meet applicable requirements of the International Plumbing Code, and AWWA/ANSI Standards.

- D. All valve construction, materials, and pressure ratings shall be selected to suit the system in which it is installed. Pressure rating and manufacturer's name shall be cast on each valve body or included in valve nameplate data. Where specified, valves shall be supplied fully packed with Teflon impregnated packing. Where possible, valves shall be of one manufacturer.
- E. Where shown on the Drawings or specified herein, valves are to include factory mounted operator, handwheel, chain wheel, extension stem, worm and gear operator, operating nut, chain, wrench, and accessories for complete operation.
- F. Where ferrous body valves are furnished with various coating options, the coatings shall comply with Section 09 90 00 PAINTING and COATINGS or, subject to OWNER's approval, be the manufacturer's most durable and corrosion resistant industrial factory coating suited to the conditions of service in which the valve is placed.
- G. Gates and Valves to open by turning counterclockwise when viewed from top.
- H. Valve body end connections to be per this specification.
- I. Unless otherwise indicated in the Drawings or specifications, the nominal size of valves to be installed is the same as the nominal diameter of the pipe to which they are connected.
- J. CONTRACTOR to be responsible for:
 - 1. Coordination of equipment dimensions, installed orientations, installation requirements, weights, and loadings with the listed Manufacturers to confirm compatibility with Manufacturers' installation and operational recommendations for this equipment.
 - 2. Incorporation of the selected equipment into the dimensional constraints of the building within the limits of the structural concrete, piping arrangement and of other equipment features as shown on the Drawings.
- K. The Contract Documents indicate specific required features of the equipment supply and systems, but do not purport to cover all details of design and construction.

2.2 VALVES

A. Ball

- 1. Tag Numbers: FV-1-6, FV-2-1, FV-2-2, FV-5-5, FV-5-6, FV-5-7, FV-5-8, FV-5-9
 - a. ½-inch to 6-inch. PVC or CPVC, Schedule 80, ball valve per ASTM F1970. PVC Type I, ASTM D 1784 Cell Classification 12454 or CPVC Type IV, ASTM D 1784 Cell Classification 23447, body, ends, nut, ball, and stem. EPDM or FKM o-rings. PTFE seat. True union type. Manual hand lever operator.
 - 1) Service:
 - a) Plant Non-Potable Water (W2)
 - 2) Manufacturer and Product: Spears; True Union 2000 Industrial Ball Valve. Or approved equal.

2. Tag Numbers: FV-1-1, FV-1-2, FV-1-3, FV-1-4, FV-1-7, FV-4-1
 - a. ½-inch to 6-inch Flanged, 3-piece, ASTM A351 CF8M stainless steel, full port, flanged ends, minimum Class 150, quarter turn, manual hand lever operator. Reinforced PTFE seats and PTFE stem seals.
 - 1) Manufacturer: Apollo Valves, 87A-200 Series. Or approved equal.
- B. Check Valves
 1. Tag Numbers: CV-1-1
 - a. ½-inch to 4-inch, PVC or CPVC, Schedule 80 flap check valve per true union end connections, 150 psi rated pressure at 73 deg F open, 75 psi rated pressure closed, maximum service temperature 140 deg F.
 - 1) Manufacturer and Product: Spears True Union Utility Swing Check Valve. Or Approved equal.
- C. Control Valves
 1. Thermostatic Temperature Control Valve
 - a. Tag Number: TV-5-1
 - b. Service: Temperature regulation of blended Non-Potable Water (NPW) supply to Polymer Wetting Head
 - c. Operating principle: bi-metal thermostatic control of blended water supply in the range of 45 to 115 °F
 - d. Operating Flow Range: 5 to 15 gpm
 - e. Valve pressure rating: 250 PSIG
 - f. Features:
 - 1) Three Way Operation
 - 2) Spring loaded Teflon chevron type packing assembly
 - 3) Thermal system line and bulb assembly partially filled with a liquid/gas combination
 - 4) Bronze body, armor and bellows; 304 stainless steel trim, stem, disk and seat
 - g. Manufacturer and Model: Spence, Series 2000 Temperature Valve, Model 2050TD-GQC
- D. Eccentric Plug
 1. Tag Numbers: FV-1-5, FV-1-8
 2. 3-inch through 12-inch Eccentric plug valve: Non-lubrication type rated 175 psig CWP, drip-tight shutoff with pressure from either direction. Body, Bonnet and Plug: cast iron,

ASTM A126, Class B, with flanged ends per ANSI B16.5, Class 150. Body bearing, bonnet bearing, and nut: 316 stainless steel. Plug Facing: CR Chloroprene. Thrust Bearing and Grit excluders: PTFE. Packing: NBR Acrylonitrile-Butadiene, V-type. Totally enclosed, geared, manual operator with handwheel, 2-inch nut, or chain wheel and chain for 6-feet or greater overhead installations.

3. Install plug stem in horizontal, with plug position per Manufacturer's recommendation for fluids with suspended solids.
 - a. Service: Digested Sludge
 - b. Manufacturer and Product: DeZurik, Eccentric Plug Valve. Or approved equal.

E. Globe Valve

1. Tag Number: FCV-2-1
2. Service: NPW (W2) 45 to 115 °F to wash water flow to Sludge Press. (Set Point: 50 gpm 80 psi)
3. Size: 3/8-inch through 2-inch
4. Valve Construction:
 - a. Bronze globe valve: Body and threaded bonnet: ASTM B62
 - b. Process Connection: MNPT
 - c. Stem: ASTM B21 brass
 - d. Disc: PTFE
 - e. Packing: Grafoil®
 - f. Handwheel: malleable iron
5. Valve Performance
 - a. Cold Working Pressure: 200 psi at 100 °F. Temperature Range: -20 to 406 °F
6. Manufacturer and Product: Apollo Valves, Part Number 33, Model 120T. Or approved equal.

F. Angle Gate Valves at Level Indicator LI-5-1

1. Tag Numbers FV-5-3 and FV-5-4
2. Contractor Furnished and Installed
3. Provide as integral part of LI-5-1 assembly

G. Instrument Isolation Valves

1. Unless otherwise indicated, instrument isolation valves shall be ball valves, 316 stainless steel, Swagelok 40 Series. Or approved equal.

H. Reduced Pressure Backflow Preventer

1. Tag Number: RPBFP-5-1
2. Service: Hot Potable Water (HW1).
3. Backflow prevention device shall conform to the current version of ANSI/AWWA Standards C511, and NSF Standard 61. Maximum working pressure 175 psi at 140-degrees F, shut off valves, check valves, automatic relief valve and test cocks. Threaded ends, quarter turn ball valves.
4. Manufacturer and Product: Watts Regulator Company. Model series LF909. Or approved equal.

I. Dry Disconnect Valve Assemblies

1. Tag Numbers FV-5-1 and FV-5-2
2. Service: Neat Polymer Solution (POLY) chemical transfer hose ends
3. Valve assembly configured as a pair of series ball valves separated by a cam and groove coupling connection. Each valve in the assembly has interlock buttons that prevent valve opening when valve assembly halves are separated. The intent is to provide spill prevention when the valve assembly is disassembled at the cam and groove connection
4. Construction 316 stainless steel
5. Valve nominal size: 1-inch
6. Elastomers
 - a. Valve Seats: PTFE
 - b. Face seal FKM
7. End connections: 1-inch FNPT
8. Dust covers provided
9. Manufacturer and Model: Banjo Dry Mate DM 100 Series Dry Disconnect Valves

2.3 OPERATORS

A. Manual Valve Operators

1. Operator force not to exceed 40 pounds under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 40 pounds

2. Position indicator on quarter-turn valves
3. Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threaded steel reach rods with internally threaded bronze or ductile iron nut
4. Galvanized and painted hand wheels
5. Lever operators allowed on quarter-turn valves 8-inches and smaller
6. Cranks on gear type operators
7. Chain wheel operator with tiebacks, extension stem, and other accessories to permit operation from normal operation level
8. Valve handles to take a padlock, and wheels a chain and padlock

B. Valve Electric Operators

1. General:
 - a. Suitable for OPEN-CLOSE or Modulating service, as indicated in detailed specification.
 - b. Size to 1½ times the required operating torque with a maximum of 100 psi on either side of valve.
2. Operator:
 - a. Hand wheel engagement shall lock out motor operation, or hand wheel shall be disengaged by motor operation.
3. Limit and Torque Switches:
 - a. Mechanical travel stops. Measurement of position should be of absolute encoder design allowing for accurate position tracking should the actuator be operated without power.
 - b. Thrust/Torque limit switches. Measurement of torque should be from direct measurement of force at the output of the actuator. Torque limit setting should be configurable between 60% to 100% of rated torque.
4. Controls
 - a. Integral operator station with OPEN-STOP-CLOSE and LOCAL-REMOTE selector switches. In the LOCAL mode, operator control shall be provided by the integral OPEN-STOP-CLOSE switch. In the REMOTE mode, operator control shall be provided by maintained closure of remote, dry OPEN, STOP, and CLOSE contacts or switches. Failure of the remote control system or components shall not prevent local selector switch control of the operator.

- b. Provide limit switches/contacts for OPEN-CLOSE indication for REMOTE position monitoring.

5. Performance Criteria

- a. Provide full range of valve actuation (open to closed and closed to open) and modulating as required, at torques equal to or less than 90% of full torque rating of actuator
- b. Elapsed time for valve travel from full open to full closed to be less than 15 seconds.
- c. Elapsed time for valve travel from full closed to full open to be less than 15 seconds.
- d. No leakage at water pressure test of 100 psi against a closed valve.
- e. Actuator is able to sustain continuous cycling of open and closure for an elapsed time of up to 30 minutes without thermal overload tripping.

2.4 ACCESSORIES

- A. Tagging: Provide a 1½-inch diameter brass or stainless steel tag for each new valve operator, or if re-tagging is required.

2.5 RECOMMENDED SPARE PARTS AND SPECIAL TOOLS

- A. Provide recommended spare parts and special tools for a two-year period of operation and maintenance for system in this Section, as applicable.
- B. All parts and tools shall be suitably marked and boxed or crated for shipment and storage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

- E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Prior to assembly all stainless steel bolts and nut threads used in the Work shall be coated with a non-seizing compound by the CONTRACTOR.
- B. Valves shall be installed with the operator/actuator in an accessible location, at the location shown on the Drawings, and in accordance with the Manufacturers' recommendations.
- C. Support valves/valve actuator assemblies and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.
- D. Flanged Valve
 - 1. Provide flat face flanges. Raised face flanges are not acceptable
 - 2. Flanged valve bolt holes shall straddle vertical centerline of pipe
 - 3. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly
- E. Threaded Ends Valve. Clean threads by wire brushing or swabbing and apply joint compound.
- F. Socket Ends Valve. Clean socket and apply joint primer and cement in accordance with the Manufacturers' recommendations.
- G. Ball Check Valve Orientation
 - 1. Install ball check valves in vertical with direction of flow based on ball designation (floating or sinking) and in accordance with the Manufacturers' recommendations.
- H. Valve Orientation
 - 1. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4-feet 6-inches or less above finished floor, unless otherwise shown
 - 2. Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4-feet 6-inches and 6-feet above finish floor, unless otherwise shown
 - 3. If no plug valve seat position is shown, orient as follows
 - a. Horizontal Flow: The flow shall produce a "seating" pressure, and the plug shall open into the top half of valve
 - b. Vertical Flow: Install seat in the highest portion of the valve
 - c. For fluids with suspended solids. Position plug/seat per Manufacturer's recommendation.
 - 4. Locate valve to provide accessibility for control and maintenance and to not interfere with adjacent equipment operation and maintenance.

- I. Chain Wheel and Guide: Install chainwheel and guide assemblies or chain lever assemblies on manually operated valves over 6-feet above finished floor. Where chains hang in normally traveled areas, use appropriate “L” type tie-back anchors

3.3 TESTS AND INSPECTIONS

- A. Testing, checkout, and startup services shall be performed by or under the technical direction of the authorized factory technician as applicable.
- B. Each device shall be tested for functional operation after the connection of external conductors and prior to equipment startup.
- C. Test all valves for the following:
 1. Smooth open and close with operating pressure on one side and atmospheric pressure on the other.
 2. Perform leakage test in both directions for valves which are subject to pressure on both sides. Valves to be verified as not passing any leakage under differential water pressure of 100 psi, or as otherwise required by the specifications.
- D. Record number of turns to open and close valve; account for any discrepancies with manufacturer's data.
- E. Under all operating conditions, valve and actuator assemblies shall:
 1. Be leak tight following completion of installation.
 2. Automated valves to respond to actuation control from Plant SCADA system, and correctly report status to the Plant SCADA system
- F. Verify and record the set point pressure for relief valves
- G. Inspect and test air release valves as pipe is filled for proper seating, release and function

END OF SECTION 40 05 50

SECTION 40 67 00 – INDUSTRIAL CONTROL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide Industrial Control Panels, complete and operable, as specified herein and as shown on the Drawings.
- B. Related Requirements:
 - 1. Section 01 25 00 - Substitution Procedures
 - 2. Section 01 33 00 - Submittal Procedures
 - 3. Division 26 - Electrical
 - 4. Section 40 90 00 - Process Instrumentation and Controls

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 SUBMITTALS

- A. Prepare, deliver, and process under provisions of Section 01 33 00 "Submittal Procedures." Requests for proposed substitute or "or-equal" equipment/systems/products will be considered in accordance with Section 01 25 00 "Substitution Procedures."
- B. Complete list of all deviations from the Drawings and Specifications.
- C. Product Data: Provide indexed catalog cut-sheets with detailed equipment specifications for each type of product indicated.
- D. Control Panel Layout Drawings: Provide scaled drawings showing the front of panel with all components, tags, nameplates, etc. Nomenclature for nameplates, tags and annunciator windows shall be included with exact lettering style shown for each. Provide scale layout drawings for all equipment back panels and sub-panel mounted components.

- E. Wiring Diagrams: Both elementary and schematic, differentiating between manufacturer installed and field installed wiring. Control logic schematics shall be in ladder diagram format, shall comply with the latest NFPA 79 and IEEE 315 standards, and shall be complete with line numbers, wire numbers and terminal numbers.
- F. Panel Factory Acceptance Test procedures for Owner's review and approval.
- G. Operation and Maintenance Data: For all products to include in operation, and maintenance manuals.
- H. Project Record Documents: Include complete control panel drawings and wiring diagrams of installed equipment conforming to installed conditions.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Control panels shall be fabricated by a company specializing in the manufacturing of industrial control panel assemblies with a minimum of three years of experience.
- B. Electrical Components, Devices, and Accessories: Components shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Control panel assemblies shall comply with the requirements of NFPA 79 (Electrical Standard for Industrial Machinery).
- D. Control and SCADA panels shall be built in accordance with Underwriter's Laboratories (UL) requirements, or an equivalent standard acceptable to the local code enforcement agency having jurisdiction. The panel fabricator shall carry a current certification with a Nationally Registered Testing Laboratory (NRTL) indicating their qualification to build and certify control panels in accordance with the applicable standards. The panels shall have NRTL labels attached to them by the panel builder. The panel builder shall provide with each panel a certification from the independent testing lab inspector that the panel is built to their standards. The current list of NRTLs that are recognized by the U. S. Occupational Safety and Health Administration (OSHA) and the State of Alaska can be found at this site:
<https://www.osha.gov/nationally-recognized-testing-laboratory-program/current-list-of-nrtls>
- E. Industrial Control Panels for installation in non-hazardous locations shall be built in accordance with UL508A.
- F. Control Panels containing Intrinsic Safety Barriers also shall meet the requirements of UL698A (Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations).
- G. Control Panels for installation in Class I, Division 2 locations shall be built in accordance with UL121201 (Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations).
- H. Explosion-Proof Control Panels for installation in Class I, Division 1 locations shall be built in accordance with UL1203.

PART 2 - PRODUCTS

2.1 CONTROL PANEL ENCLOSURES

- A. Enclosure Size: Size enclosures as required per project drawings.
- B. Control panel enclosures shall be manufactured by Hoffman or approved equal.
- C. Unless indicated otherwise, control panels shall be housed in NEMA-rated enclosures as shown on the Drawings. Control panels shall be either wall-mounted, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.
 - 1. All control panels installed in process areas shall be NEMA 4X, unless noted otherwise on the Drawings.
- D. Material: Stainless steel as Drawings Indicate:
 - 1. 14-gauge minimum steel, all welded construction.
- E. Panel Access:
 - 1. Provide continuous hinged doors which, when open, expose a minimum of 80% of panel interior.
 - 2. Provide print pockets on each door.
- F. Panel Subplate Layout:
 - 1. Mount panel subplates on collar studs for easy removal.
 - 2. Provide a 3-inch minimum space between subplates and panel exterior walls for entering field wiring.
 - 3. Provide 1-inch minimum space between subplate mounted components and wire ducts.
 - 4. Provide 20% spare terminal blocks.
 - 5. Provide 1.5-inch minimum space between terminal blocks and wire ducts and between adjacent columns of terminal blocks.
 - 6. Provide a minimum of 15% unused subplate space.
- G. Panel Wiring:
 - 1. Use 16 AWG minimum, Class C stranded copper, 90 degree C MTW or THHN for internal panel control wiring.
 - 2. Use two conductor, 18 AWG, shielded cable for all instrumentation signals.
 - 3. Bundle and tie all panel wiring not routed in wire ducts.

4. Identify each wire with the same unique number at each terminal.
5. Color code control wiring as follows:
 - a. Red: All AC control circuits de-energized when the panel is de-energized.
 - b. Yellow: All interlock AC control circuits wired from an external power source.
 - c. Blue: All +24 VDC control circuits.
 - d. White with Blue Stripe: All 24 VDC Common (0 VDC) Circuits.
 - e. Black: All AC power distribution circuits within panel.
 - f. White: Grounded power circuit conductor.
 - g. Green: (with or without yellow stripe) Equipment grounding conductors.

H. Identification:

1. Provide all front of panel mounted components with an engraved laminated black plastic identification nameplate indicating the function of the component.
2. Provide all components within the panel with machine-printed permanent identification labels indicating the tag name of the component as indicated on the wiring diagrams.
3. All nameplate wording shall be subject to approval by the Engineer.
4. Provide all wiring within the panel with tubular heat-shrinkable nylon, machine-printed wire labels at each termination. Tag markings shall correspond to the panel wiring diagrams. Wire labels shall be unique for each conductor. Repeated use of the same wire label for differing conductors at the same voltage/potential is not allowed.

2.2 SWITCHES, PUSHBUTTONS AND LIGHTS

- 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. Allen Bradley
 2. Cutler Hammer, Inc
 3. General Electric Company
 4. Square D Company
 5. ABB (Entrelec)
- B. General: Provide UL listed, NEMA 12 rated, 30mm heavy duty industrial pilot and switch devices unless otherwise indicated.

- C. Contacts: NEMA A600 AC.; NEMA 300 DC.
- D. Legend Plate: Manufacturer's standard compatible with unit.

2.3 RELAYS

- 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. Allen Bradley.
 - 2. General Electric Company.
 - 3. Square D Company.
 - 4. Phoenix Contact.
 - 5. ABB.
 - 6. Siemens.
- B. Type: DIN rail base, plug-in with manual operator, indicating light and transparent cover.
- C. Coil: 120VAC or 24VDC.
- D. Contacts: Rated 3A @ 120VAC

2.4 INTRINSIC SAFETY BARRIERS

- 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. MTL.
 - 2. Stahl.
 - 3. Turck.
 - 4. Pepperl-Fuchs.
- B. UL913 listed.
- C. DIN rail mounted.
- D. Install in accordance with manufacturer's control drawing.
- E. Provided physical segregation from non-I.S. wiring via partition or suitable clearances. Clearly identify areas designated in panel dedicated to I.S. wiring.
- F. Label all I.S. wiring and raceways in accordance with UL and NEC requirements.

2.5 TERMINAL BLOCKS

- 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. Allen Bradley.
 - 2. Entrelec.
 - 3. Phoenix Contact.
- B. Type: Fusible or non-fusible as required. DIN-rail mounted, box lug with pressure plate type or binding head screw type with pressure plate; with white marking strip.
- C. Identify all terminal strips and individual terminals using manufacturer's permanent plastic insert label strips. Identification of terminal strips shall match the designations indicated in the drawing set.
- D. Provide external fusing for components in accordance with manufacturer's installation instructions.

2.6 PANEL ACCESSORIES

- A. Provide LED light fixture in each control panel section.
- B. Provide 120 vac, DIN Rail mount GFCI convenience receptacle in each control panel section.
- C. Provide equipment grounding bus in each control panel. Square-D PK15GTA, Hoffman PGS or equal.
- D. Spare fuses. Provide 1 spare fuse for each 10 fused circuits in the panel with a minimum of 5 fuses of each type used in the panel. Fuses shall be provided suitably packaged in a fuseholder box installed in panel.
- E. Provide 120 vac surge suppressor on incoming power circuit to panel. Suppressor shall be Emerson Islatrol or equal, appropriately sized for panel input power circuit.
- F. Panel wiring shall be routed in side-slotted PVC wiring duct, Panduit, T&B or equivalent. Panel fabricator to ensure that wiring ducts are appropriately sized to accommodate control panel conductors at a maximum fill of 40% of duct cross sectional area. Sizing of ducts shall be performed assuming full utilization of all spare terminals and I/O channels in panel.
- G. Free standing panel assemblies will be provided with lifting lugs to facilitate handling in the field.

PART 3 - EXECUTION

3.1 FABRICATION AND TESTING

- A. Where possible, maintain segregation between groups of wiring of different voltages or signal types. AC and DC wiring should be routed separately and cross at right angles.
- B. Neatly dress all exposed wiring using spiral wrap or tubular nylon mesh. Secure exposed wiring bundles with tie wraps and adhesive anchors. Provide service loop for cable bundle to door or other wiring subject to flexing.
- C. Control panel fabricator to provide witnessed Factory Acceptance Test (FAT) of control panels prior to control panel shipment.
 - 1. FAT shall include functional test of control panel power system, all input/output points and all communications links. Prior to FAT, contractor shall provide power and minimal configuration necessary to establish communications between all network nodes and FAT shall demonstrate error-free communications traffic between all network nodes in a simultaneous fashion.
 - 2. Panel fabricator shall provide all necessary tools, manpower and equipment to demonstrate the functionality of the control panel.
 - 3. Test equipment used in the FAT shall carry a current NIST-Traceable calibration certificate.
 - 4. Panel fabricator shall submit all test procedures to Owner's representative for approval prior to execution. Provide 2 weeks' notice to Owner's Representative prior to test to allow for coordination of travel and accommodations. Owner may choose to forgo witnessed testing or witness via video at their discretion. Fabricator shall make all necessary arrangements to allow for remote (video) witness of panel FAT if required. Execution of FAT shall be documented and all deficiencies identified in the test shall be documented.
- D. Panel fabricator to provide complete control panel record drawings after any non-compliance items have been addressed.
- E. Control panels shall be fabricated, NRTL evaluated in accordance with UL508A and other applicable standards and suitably listed prior to shipment from panel fabricator's shop.

3.2 INSTALLATION

- A. Preparation for Shipment and Shipping.
 - 1. Resolve all deficiencies identified during FAT process prior to shipment.
 - 2. Panels shall be crated for shipment and suitably protected. Install protective material as required to ensure panel surfaces and componentry is not damaged during shipment. Provide bracing for internal components of panel where required. Protect panel from damage from moisture during shipment.

- B. Panel installation shall be in accordance with Specification Section 40 90 00 – “Process Instrumentation and Controls.”
- C. Install equipment as indicated, in accordance with the manufacturer’s instructions and in compliance with recognized industry practices to ensure products fulfill requirements.

3.3 FIELD QUALITY CONTROL

- A. Check circuitry for electrical continuity and short circuits prior to placing equipment in service.

3.4 DEMONSTRATION AND TRAINING

- A. After completion of installation and startup service, demonstrate functioning of products in accordance with the requirements to the Owner. Train Owner's maintenance personnel to adjust, operate, and maintain products.

END OF SECTION 40 67 00

SECTION 40 71 10 - FLOW MEASURING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, functional test, and provide startup services for flow measuring devices and related appurtenances, complete and functional with electrical and control systems, as specified herein and as shown on the Drawings.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section
- B. 01 10 00 – Summary
- C. 01 14 00 – Project Constraints
- D. 01 33 00 – Submittal Procedures
- E. 01 60 00 – Product Requirements
- F. 01 75 00 – Starting and Adjusting
- G. DIVISION 26 – Electrical
- H. 40 90 00 – Process Instrumentation and Controls

1.3 QUALITY ASSURANCE

- A. “Smart” transmitters shall be furnished when or whenever possible.
- B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL), Factory Mutual (FM), or other Nationally Recognized Testing Laboratory (NRTL) suitable to the State of Alaska.
- C. All parts and components shall be of a single manufacturer and designed as a single system.

1.4 SUBMITTALS

- A. Prepare, deliver, and process under provisions of Section 01 33 00 SUBMITTAL PROCEDURES. Requests for proposed substitute or “or-equal” equipment/systems/products will be considered in accordance with Section 01 25 00 SUBSTITUTION PROCEDURES.
- B. Complete list of all deviations from the Drawings and Specifications.

- C. Shop Drawings. Provide the following:
1. Product data and cut sheets for make and model of components intended for use in the work.
 2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 3. Installation, Operations and Maintenance manuals. Including Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.

PART 2 - PRODUCTS

2.1 FLOW ELEMENT, INDICATOR/TRANSMITTER; MAGNETIC FLOW METER

- A. Tag Number: FIT-1-1
1. Service: Sense and indicate flow and totalized flow of Settled Digested Sludge, and transmit flow data to the Screw Press Control Panel, LCP-2-1.
 2. Area Classification: Unclassified. Unless noted otherwise on a Code Analysis Drawing.
- B. Tag Number: FIT-5-1
1. Service: Sense and indicate flow and totalized flow of Polymer, and transmit flow data to the Screw Press Control Panel, LCP-2-1.
 2. Area Classification: Unclassified. Unless noted otherwise on a Code Analysis Drawing.
- C. Magnetic flow meter systems shall be of the low frequency electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flow meter system. Each magnetic flow metering system shall include a metering tube, transmitter, and flow meter grounding rings.
- D. Magnetic flow meters and electronics shall be manufactured at facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.
- E. The system shall be capable of measuring flow bi-directional in a range no less than -39 ft/sec to +39 ft./sec. Flow rates of 0.04 ft/sec in either direction shall be sensible.
- F. Metering Tube: The metering tube shall have the following:
1. Carbon steel, rated for water at a working pressure of 150 psi and have flat faced flanged connections in accordance with ANSI 16.5 Class 150.
 2. Utilize a minimum of 2, self-cleaning electrodes. Reference electrode as required.

3. Liner, electrodes, and grounding rings in conformance with the Manufacturer's recommendation for the meter's intended service.
 4. Meter exterior coating system: polyurethane (≥ 2.6 mills).
- G. Transmitter: The microprocessor-based signal converter/transmitter shall include:
1. DC pulse technique to drive flux-producing coils.
 2. DC pulse signal from the tube converted to a standard 4-20 mA signal into a minimum of 500 ohms.
 3. HART communications.
 4. Operator interface with a 2 line display each having 16 characters minimum for flow rate, percent of span, and totalizer.
 5. Programmable zero return to provide a consistent zero output signal in response to an external dry contact closure.
 6. Bi-directional flow
 7. Automatic range change
 8. Programmable parameters including meter size, full scale Q, magnetic field frequency, primarily constant, time constant
 9. Data retention for a minimum of 5 years without auxiliary main or battery power
 10. Self-diagnostics and automatic data checking
 11. Protected terminals and fuses in a separate compartment which isolates field connection from electronics.
 12. Low copper aluminum housing, Type 4X, IEC 60529, IP66 with polyurethane coating and Buna-N gaskets.
 13. Electrical Connections: ½-inch NPT.
 14. Can tolerate ambient temperature operating limits of -4 to 140 °F (-20 to 60 °C).
 15. Power Consumption not to exceed 15 watts
 16. Power Supply: 24 VDC +/-10 percent
- H. Performance Requirements
1. Turn-on time shall be no greater than 5 minutes to rated accuracy. Startup time shall be no greater than 50 ms from no flow.
 2. Low flow cutoff shall be adjustable down to 0.01 ft./s. The transmitter shall output a linear signal to 110% of upper range.

3. Standard system accuracy: $\pm 0.25\%$ of rate ± 1.0 mm/sec from 0.04 to 6 ft/sec (0.01 to 2 m/sec); above 6 ft./sec (2 m/sec), $\pm 0.25\%$ of rate ± 1.5 mm/sec above ft/sec.

I. Manufacturer and Model:

1. Rosemount 8705 flow tube with Rosemount 8732E integral transmitter
2. FIT-1-1. 3-inch, Settled Digested Sludge Flow Meter. Neoprene liner, two bulletnose and one reference stainless steel electrodes.
 - a. Flow tube: 8705 N S B 030 F 1 M0 B3
 - b. Transmitter: 8732E M T 2 A 1 DA1
3. FIT-5-1. 1½-inch, PolymerFlow Meter. PTFE liner, 2 standard Nickel Alloy 276 electrodes, grounding rings.
 - a. Flow tube: 8705 T H A 015 F 1 M0 G1 B3
 - b. Transmitter: 8732E M T 2 A 1 M4

2.2 VARIABLE ORIFICE FLOW INDICATOR (FI)

A. Tag Number: FI-2-1

1. Service: NPW (W2) 45 to 115 °F to monitor wash water flow to Sludge Press. (Set Point: 50 gpm 80 psi)
2. Construction
 - a. Molded polysulfone tube with 304 stainless steel case and polycarbonate shield
 - b. 2-inch FNPT PVC inlet and outlet fittings
 - c. Teflon float
 - 1) Accuracy: 6% of full-scale
 - d. Viton elastomers
 - e. Scale Gradations: gpm
 - f. Flow Range: 60 gpm
 - g. Turn Down: 10:1
 - h. Maximum Pressure: PVC Fittings in specified size, 125 psi
3. Manufacturer and Model
 - a. King Instrument 7311 3610 Series Order Number 91W.

2.3 ISOLATION VALVES

- A. See specification Section 40 05 50 PROCESS VALVES AND OPERATORS.

PART 3 - EXECUTION

3.1 GENERAL

- A. Flow measuring and control systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested according to Section 40 90 00 PROCESS CONTROL AND INSTRUMENTATION SYSTEMS.

3.2 INSTALLATION

- A. Instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 40 PROCESS INTERCONNECTIONS, as shown on the Drawings, and per the Manufacturer's instructions.

END OF SECTION 40 71 10

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SECTION 40 72 73 – SIGHT LEVEL GAGES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, functional test, and provide startup services for sight level gages complete and functional with electrical and control systems, as specified herein and as shown on the Drawings.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. 01 10 00 – Summary
- C. 01 14 00 – Project Constraints
- D. 01 33 00 – Submittal Procedures
- E. 01 60 00 – Product Requirements
- F. 01 75 00 – Starting and Adjusting
- G. DIVISION 26 – Electrical
- H. 40 90 00 – Process Instrumentation and Controls

1.3 QUALITY ASSURANCE

- A. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL), Factory Mutual (FM), or other Nationally Recognized Testing Laboratory (NRTL) suitable to the State of Alaska.
- B. All parts and components shall be of a single manufactured and designed as a single system.

1.4 SUBMITTALS

- A. Prepare, deliver, and process under provisions of Section 01 33 00 SUBMITTAL PROCEDURES. Requests for proposed substitute or “or-equal” equipment/systems/products will be considered in accordance with Section 01 25 00 SUBSTITUTION PROCEDURES.
- B. Complete list of all deviations from the Drawings and Specifications.
- C. Shop Drawings. Provide the following:

1. Product data and cut sheets for make and model of components intended for use in the work.
2. Product dimensional information for equipment and components to be used in this Project
3. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
4. Installation, Operations and Maintenance manuals. Including Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.

PART 2 - PRODUCTS

2.1 SIGHT LEVEL GAGE (LI-5-1)

- A. Function: Provide visual indication of liquid level in Polymer Storage Tank T-5-1.
- B. Description: Glass tube is affixed to the wall of the polymer bulk storage tank via bulkhead fittings that allow the liquid in the tank to hydrostatically equilibrate with the liquid level in the glass tube. This enables operations personnel to visually see the liquid level in the tank. Isolation valves at each end (top and bottom) of the glass tube isolate the tube from the tank, providing a means for removing the tube for cleaning or replacement. A drain valve on the tube allows the contents of the tube to be evacuated before tube removal.
- C. Service temperature: maximum 65 degrees F
- D. Construction
 1. Valves, rods and fittings, 316 stainless steel
 2. ¾-inch nominal glass tube diameter
 3. Glass length 60 inches
 4. Glass seal: PTFE with Hypalon
 5. Stem Packing: Braided PTFE with Aramid
 6. Top and bottom angle valves
 7. Valve Handles: Aluminum
 8. Standard glass type: High Pressure
- E. Manufacturers and Products:
 1. Apollo Valves Liquid Level Gauge, Series No. 23, 60 inches long, top and bottom angle valves

PART 3 - EXECUTION

3.1 GENERAL

- A. Liquid level measuring and control systems shall be handled, installed, pre-commissioned, and performance tested according to Section 40 90 00 PROCESS CONTROL AND INSTRUMENTATION SYSTEMS.

3.2 INSTALLATION

- A. Instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 40 PROCESS INTERCONNECTIONS, as shown on the Drawings, and per the Manufacturer's instructions.
- B. Supports: Provide all hangers, supports, guides, anchors, bolts, and mounting accessories as required for the installation.
- C. Isolation Valves: All instrument mounting nipples and sensing lines shall be provided with isolation valves at the pipe tap.
- D. Instrument Manifolds: All pressure transmitters shall be provided with instrument manifolds for testing and calibration. All manifolds shall be independently supported.

END OF SECTION 40 72 73

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SECTION 40 90 00 - PROCESS INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 INSTRUMENTATION AND CONTROLS ROLES AND RESPONSIBILITIES

A. Responsibilities:

1. The CONTRACTOR, through the use of an INTEGRATOR (TECPRO), an INSTRUMENTATION SUPPLIER, PANEL FABRICATOR, and qualified electrical and mechanical installers, shall be responsible to the OWNER 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, it is the intent of these Specifications that the CONTRACTOR use the specified INTEGRATOR who will be responsible to the CONTRACTOR for the integration of the devices provided under other sections, with the objective of providing a completely integrated control system free of signal incompatibilities. The INTEGRATOR may be the INSTRUMENTATION SUPPLIER.

3. Roles

a. INTEGRATOR (TECPRO)

TECPRO LTD.

1977 E Bogard Rd,

Wasilla, AK 99654

907-348-1800

- 1) No substitutions for the INTEGRATOR will be accepted
- 2) Shall perform the following work:
 - a) Develop, implement, and commission PLC and SCADA programs for non-packaged systems.
 - b) Prepare documents to record the functional test of the programs

b. INSTRUMENT SUPPLIER

- 1) Prepare hardware submittals
- 2) Prepare the test plan, the training plan, and the spare parts submittals
- 3) Procure hardware
- 4) Oversee and certify hardware installation
- 5) Oversee, document, and certify loop testing
- 6) Prepare Technical Manuals
- 7) Prepare edited set of record drawings

- 8) Any Instrumentation Supplier responsibilities in addition to the list above are at the discretion of the CONTRACTOR. Additional requirements in this Section and throughout Division 40 which are stated to be the CONTRACTOR's responsibility may be performed by the Instrumentation Supplier if the CONTRACTOR and Instrumentation Supplier so agree.

c. PANEL FABRICATOR

- 1) PANEL FABRICATOR Qualifications: The PANEL FABRICATOR shall have the resources, space, and personnel needed to design and fabricate the panels. The PANEL FABRICATOR shall meet the following minimum qualifications:
 - a) The PANEL FABRICATOR shall have been in the business of building panels and bonding the construction of these panels for at least 5 years. The bonding shall be under the name and ownership of the company fabricating the panels for this project.
- 2) The PANEL FABRICATOR shall build the panels to UL standard 508A, shall be certified to build panels to UL standard 508A, and shall attach a UL label on all new panels.
- 3) The PANEL FABRICATOR shall, where required, make all wiring changes to new and existing control panels and MCC. The changes shall be made to UL standard 508, or equal standard. The CSPDF shall provide a UL engineer to inspect the changes and certify that the panel meets the standard or provide a list of deficiencies.
- 4) Edit contract loop drawings and control panel designs to show all changes to the design.
- 5) Fabricate the panels
- 6) Test the panels at the factory.
- 7) Ship the panel.
- 8) Assist the CONTRACTOR during startup and commissioning

1.2 VARIABLE FREQUENCY DRIVES

A. Pump VFDs covered in this specification section:

1. Digested Sludge Pump P-1-1 and P-1-2
2. Neat Polymer Storage Tank Mixer MXR-5-1

B. This specification is to cover a Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. It is required that the drive manufacturer have an existing:

1. Sales representative for drive products, with expertise in pump controls.
2. An independent service organization.

- C. The drive manufacturer shall supply the drive and all necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFD's that are manufactured by a third party and "brand labeled" shall not be acceptable. All VFDs installed on this project shall be from the same manufacturer.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE)
 - a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
2. Underwriters' laboratories
 - a. UL508C
3. National Electrical Manufacturer's Association (NEMA)
 - a. ICS 7.0, AC Adjustable Speed Drives
4. IEC 16800 Parts 1 and 2
5. National Electric Code (NEC)
 - a. NEC 430.120, Adjustable-Speed Drive Systems
6. International Building Code (IBC)

B. Qualifications:

1. VFDs and options shall be UL listed as a complete assembly. The base VFD shall be UL listed for 100 KAIC.
2. CE Mark – The VFD shall conform to the European Union Electro Magnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level.
3. Acceptable Manufacturers
 - a. ABB ACS Series.
 - b. Alternate manufacturer's requests must be submitted in writing to the Engineer for approval at least 10 working days prior to bid. Approval does not relieve supplier of specification requirements.
 - c. VFDs that are manufactured by a third party and "brand labeled" are not acceptable.

PART 2 – PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

- A. The VFD package as specified herein shall be enclosed in an IP20 enclosure, completely assembled, and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +/-10% nominal voltage as a minimum.
 - 1. Environmental operating conditions: VFDs shall be capable of continuous operation at -10 to 500 C (14 to 1220 F) ambient temperature as per VFD manufacturers documented/submittal data. Not acceptable are VFD's that can only operate at 40 C, altitude 0 to 3300 feet above sea level, or less than 95% humidity, non-condensing. All circuit boards shall have conformal coating.
 - 2. An optional enclosure shall be rated UL type 1. NEMA type 1 enclosures are not acceptable (must be UL Type 1).
- B. All VFDs shall have the following standard features:
 - 1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
 - 2. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery back up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. Capacitor back-up is not acceptable. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.
 - 3. The VFD's shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.
 - 4. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, the VFD shall cycle the cooling fans on and off as required.
 - 5. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).

6. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
 7. The overload rating of the drive shall be 150% of its normal duty current rating for 1 minute every 10 minutes, 180% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.
 8. The VFD shall include a coordinated AC transient surge protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground).
 9. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of broken belt or mechanical failure / jam condition causing motor overload
 10. The VFD shall include multiple "two zone" PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for "two zone" control.
 11. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.
 12. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.
 13. The VFD shall have the ability to operate either an induction motor or permanent magnet motor.
 14. The VFD shall support the Safe torque off (STO) function according to standards EN 61800-5-2; EN/ISO 13849-1:2006, IEC/EN 60204-1:1997; EN 61508:2002, EN 1037:1996, and IEC 62061:2005 (SILCL 3).
 15. The VFD shall have the ability to be connected to a common DC bus system. Where the drive can be powered and regenerate onto the common DC bus system.
- C. All VFDs to have the following adjustments:
1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.
 2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two

independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.

3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (ie. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.
4. Two (2) programmable analog inputs shall accept current or voltage signals.
5. One (1) programmable analog outputs (0-20ma or 4-20 ma). The output may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.
6. Five (5) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC or 24VAC.
7. One (1) programmable digital Form-C relay output. The relay output shall include programmable on and off delay times and adjustable hysteresis. The relay shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Output shall be true Form-C type contacts.
8. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.
9. Seven (7) programmable preset speeds.
10. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.
11. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.
12. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.
13. The VFD shall include password protection against parameter changes.

- D. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include the following assistants:
 - 1. Start-up assistant
 - 2. Parameter assistants
 - 3. Maintenance assistant
 - 4. Troubleshooting assistant
 - 5. Drive optimizer assistants

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.
- B. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current. Caution: VFDs supplied without internal reactors have substantially higher input current ratings, which may require larger input power wiring and branch circuit protection. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 PRODUCT SUPPORT

- A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line shall be available.

3.3 WARRANTY

- A. The VFD Product Warranty shall be 12 months from the date of installation, not to exceed 24 months from the date of shipment. A toll free 24/365 technical support line shall be available.

3.4 FUNCTIONAL NARRATIVE

- A. The following paragraphs describe the automated monitoring, control, and alarm annunciation features to be provided for the Project.
- B. Screw Press Overview
 - 1. The activated sludge treatment process creates waste biosolids as waste activated sludge (WAS). WAS is pumped to the plant's aerobic digester as needed to maintain biological process control in the plant's secondary treatment train. Aerobic digestion provides supplemental stabilization for waste biosolids.
 - 2. Upon initiating a call to operate the mechanical sludge dewatering screw press, gravity thickened Digested Sludge (DS) is withdrawn from the Digester, dosed with polymer, and pumped to the screw press.
 - 3. Pumped sludge enters and flows upward through a vertical cylindrical flocculation tank fitted with vertical mechanical paddle mixer. Sludge overflow from the flocculation tank enters the screw press by gravity.
 - 4. Inside the press, the sludge is applied to the outside of a tapered screw auger encased by perforated screens. Freely draining water separates from the sludge through the perforated screens and exits the press as "filtrate".
 - 5. The tapered auger is motor driven by a gearmotor assembly.
 - 6. As the auger rotates, it moves remaining sludge solids to the compression zone of the press where the annular space between the tapered screw auger and screens becomes volumetrically smaller. A pneumatically actuated counter pressure plate at the tapered end of the auger maintains pressure on the sludge within the compression zone.
 - 7. Compressed air (CA) and pneumatic controls on the screw press actuate pneumatic cylinders attached to the counter pressure plate against which sludge is pressed in the compression zone of the press.
 - 8. Dewatered sludge cake discharges out a bottom chute at the far end of the tapered screw auger.
 - 9. Filtrate from the press is collected in a drain pan at the bottom of the press and discharged to drain.
 - 10. The press is configured with a pair of wash water spray rings that direct high pressure water onto the basket screens in the press. Wash water application occurs either when manually initiated by operations personnel, or during scheduled time events selected by operations personnel at the press control panel. Pressurized non-potable wash water (W2) is applied to the wash water rings from the water booster pump skid.

C. Screw Press Automation

1. Andritz screw press control features are outlined in their submittal package documentation attached to the Project specifications. Functional checkout to include verification of the following items.
2. Simulated Input and Response Verification
 - a. Prior to energizing process equipment, apply simulated input communications to the Andritz control panel PLC to confirm automated responses for the following:
 - 1) Shut down and de-energizing screw press operations, display of alarm condition text upon any of the following occurring
 - a) Depression of Andritz panel E-Stop mushroom button switch
 - b) Screw Press safety pullcord engagement
 - c) Andritz control panel
 - i. Master control relay (MCR) fault for either MCR713 or MCR715
 - ii. Screw Press VFD fault
 - iii. Air compressor fault
 - iv. Conveyor fault
 - v. High torque on screw press drive fault
 - vi. High sludge feed pressure fault
 - vii. Spray arm actuator fault
 - viii. Floc tank high level fault
 - ix. Control panel cooling fan fault
 - x. Low wash water (W2) water pressure
 - d) Alarm condition reported by the screw conveyor control panel LCP-4-1
 - e) Alarm condition reported by the polymer dosing pump panel LCP-5-2
 - f) Alarm condition reported by the digested sludge pumps panel LCP-1-1
 - g) Alarm condition reported by wash water booster pump panel LCP-3-1
 - 2) Prior to energizing process equipment, confirm display of the following on the Andritz control panel operator interface terminal (OIT) graphical displays screen
 - a) Screw press main drive amperage as 0 amps without applied power
 - b) Screw press drive speed as 0 rpm without applied power
 - c) Screw press pressure as 0 psi without applied sludge
 - d) Torque set point valve as recommended by Andritz start up tech for this Project.
 - e) Polymer dosing flow as reported by FIT-5-1
 - f) Digested sludge flow as reported by FIT-1-1
 - 3) Prior to energizing process equipment, confirm screw press dewatering operations operator selectable set point values for the following:
 - a) Polymer dosing flow rate
 - b) Digested sludge flow
3. Manual Operational Mode

- a. Confirm ability to enable/disable the following from the “pushbuttons” displayed on the Operator Interface Touch (OIT) graphical interface screen installed on the door of the Andritz screw control panel.
 - 1) Emergency Stop for entire process
 - 2) Screw Press
 - a) Tapered Screw Auger Drive On/Off
 - b) Spray Arm Extend/Retract Cycle
 - c) Pneumatic Air Supply Choke Solenoid Valves Open/Close
 - d) Wash Water Solenoid Valves 1 and 2 Open/Close
 - e) Screw Press Air Compressor On/Off
 - f) Screw Press Flocculation Tank Paddle Mixer On/Off
 - 3) Digested Sludge Pumps P-1-1 and P-1-2 On/Off
 - 4) Polymer Blending System On/Off
 - 5) Screw Conveyor SC-4-1 On/Off
 - b. Confirm display of process status indicators for
 - 1) Screw Press Running/Stopped
 - 2) Screw Press Drive motor amps
 - 3) Screw Press speed in RPM
 - 4) Screw Press pressure in PSI
 - 5) Floc Tank Liquid Level
 - 6) Status of Polymer Blending System
 - 7) Status of Digester pumps
4. Auto Operational Mode
- a. Upon selection of screw press operations in Auto Operational Mode, verify the following occurs
 - 1) Initiation of air compressor as needed to maintain operator selected set point pressure
 - 2) Screw press main drive energizes
 - 3) Andritz control panel cooling fan energizes
 - 4) Screw Conveyor SC-4-1 energizes
 - 5) Polymer Blending System energizes and delivers measured polymer flow to the polymer injection ring on the digested sludge line
 - 6) Digested Sludge Pump P-1-1 or P-1-2 is energized depending on which pump is selected by operator for operation at Digested Sludge Pump control panel LCP-1-1.
 - 7) Screw press floc tank paddle mixer motor drive energizes
 - b. After successful initiation of screw press operations, verify

- 1) Displays of dewatering process status are correctly indicated on operator interface terminal (OIT) graphical display screen at Andritz control panel
 - a) Screw Press Running/Stopped
 - b) Screw Press Drive motor amps
 - c) Screw Press speed in RPM
 - d) Screw Press pressure in PSI
 - e) Floc Tank Level
 - f) Polymer dosage flow as reported by FIT-5-1
 - g) Digested sludge pumped flow as reported by FIT-1-1
- 2) Displays of polymer flow agree between FIT-5-1 and the displayed value of polymer flow at the Andritz control panel OIT.
- 3) Displays of digested sludge flow agree between FIT-1-1 and the displayed value of digested sludge flow at the Andritz control panel OIT.
- 4) Operator set point values for polymer flow entered into the Andritz control panel OIT are matched by the delivery rate of polymer reported by FIT-5-1
- 5) Operator set point valves for digested sludge flow at the Andritz control panel OIT are matched by the delivery rate of digested sludge reported by FIT-1-1.
- 6) Wash water cleaning cycle for screw press is functional and meets the following requirements
 - a) Wash water supply is provided at flow and static pressure required by Andritz
 - b) The screw press wash water cycle occurs on schedule selected by operator for occurring as entered in Andritz control panel
 - c) The screw press wash water spray arm extends/retracts as intended by Andritz for screen press washing.

D. Sludge Screw Conveyor Overview

1. Dewatered sludge cake falling out of the press enters the lower end of an inclined screw conveyor auger. The Sludge Screw Conveyor carries the sludge cake up its incline and deposits it by gravity into the City's roll off dumpster. The dumpster also receives raw sewage screenings from the existing headworks drum screens.
2. The auger's operation is initiated upon a call to run by the screw press control panel. It is maintained operational until de-energized by the press control panel.

E. Sludge Screw Conveyor Automation

1. Simulated Input and Response Verification
 - a. Prior to energizing process equipment, apply simulated input communications to the Screw Conveyor control panel LCP-4-1 to confirm automated responses for the following:
 - 1) Shut down and de-energizing screw press operations, shut down and de-energizing Screw Conveyor SC-4-1 operations, display of alarm condition text at Andritz control panel OIT upon any of the following occurring
 - a) Screw Conveyor SC-4-1 safety pullcord engagement

- b) Screw Conveyor SC-4-1 gearmotor assembly motor drive excessive torque operating condition.
 - c) Loss of rotational motion for screw auger in Screw Conveyor SC-4-1
 - d) Screw Conveyor SC-4-1 control panel LCP-4-1 reports alarm condition including failure to energize upon call to run
 - b. Prior to energizing process equipment, confirm display of the following on the Screw Conveyor Control Panel SC-4-1
 - 1) Control panel power light
 - a) White when panel power applied
 - b) Off when panel power de-energized
 - 2) Control panel screw conveyor operational status light
 - a) Green when energized
 - b) Off when de-energized
 - 3) Control panel screw conveyor alarm light
 - a) Red when an alarm condition occurs including
 - i. Emergency E-Stop mushroom button depressed
 - ii. Safety pullcord for screw conveyor SC-4-1 engaged
 - iii. Screw conveyor SC-4-1 gearmotor drive over-torque condition
 - iv. Loss of rotational motion for screw conveyor SC-4-1 auger
 - v. Failure of motor drive to energize when called to run
- 2. Manual Operational Mode
 - a. With Hand Switch HS-4-1 HOA in Hand position, confirm
 - 1) Gearmotor drive energizes and initiates rotational motion for Screw Conveyor SC-4-1
 - 2) Rotational speed of screw auger is per specified speed.
- 3. With Hand Switch HS-4-1 HOA in Off position, confirm gearmotor drive -de-energizes and stops rotational motion for Screw Conveyor SC-4-1
- 4. Confirm function of reversing screw rotational direction by operating HS-4-1 FOR by switching position during forward operation from F to R position, allowing time for rotational motion of conveyor to come to halt between switching operations.
- 5. Auto Operational Mode
 - a. With Hand Switch HS-4-1 HOA in Auto position, confirm
 - 1) Gearmotor drive energizes and initiates rotational motor for Screw Conveyor SC-4-1 upon receiving call to run from Andritz control panel.
 - 2) Gearmotor drive de-energizes and terminates rotational motor for Screw Conveyor SC-4-1 upon receiving call to stop from Andritz control panel.

F. Polymer Preparation Overview

1. Polymer solution is prepared by diluting neat emulsion polymer with tempered non-potable water in a polymer makeup unit.
2. Emulsion polymer stock solution used in the sludge dewatering process is stored in the plant's polymer preparation area in a dedicated neat polymer stock solution tank T-5-1. Tank T-5-1 is periodically filled by operations personnel from poly barrels of neat polymer delivered to the treatment plant by the polymer supplier.
3. As recommended by the emulsion polymer manufacturer and supplier, the stored emulsion polymer should be periodically mechanically mixed in T-5-1. This objective is achieved by the operations personnel by periodically operating MXR-5-1 which is a vertical mixer mounted to the top of T-5-1.
4. An emulsion polymer makeup skid configured with an on-board progressive cavity pump draws polymer stock solution from T-5-1 and discharges it to a blending unit where Tempered W2 (TW2) water is added and mixed with polymer to produce a dilute polymer solution.
5. Dilute polymer solution is conveyed under the pressure of the W2 supply water through polymer process piping before entering the polymer injection mixing ring.
6. A thermal flow sensor mounted on neat polymer piping on the polymer makeup skid monitors polymer flow to the suction side of the progressive cavity pump on the skid. Confirmation of flow is a prerequisite for maintaining polymer pump operations.
7. A solenoid valve on the TW2 water supply at the polymer makeup skid admits water flow to the polymer makeup skid upon a call for polymer from the Andritz panel.
8. A variable orifice flow indicator on the TW2 water supply at the polymer makeup skid provides TW2 water use information for the polymer makeup unit.
9. A pressure differential instrument monitors the TW2 pressure drop across the polymer blending unit.

G. Polymer Preparation Automation

1. Prior to Startup verify the following
 - a. Plumbing connections have been made and tested for leaks
 - b. All electrical power and control connections completed and functional
 - 1) Comm between LCP-5-1 and Andritz panel
 - 2) Comm and control between LCP-5-1 and MXR-5-1
 - 3) VFD for MXR-5-1 is configured at LCP-5-1
 - c. Water supply is connected and any manual supply valves are open.
 - d. Seal Flush Water Supply
 - 1) Set seal water supply to manufacturer's required flow setting

- e. LCP-5-1 Panel
 - 1) Switches functional including
 - a) Panel disconnect switch
 - b) Emergency E-Stop switch
 - c) HOA for polymer makeup skid operation
 - 2) Panel Front Controls
 - a) Potentiometer for neat polymer pump speed control
 - b) Potentiometer for polymer makeup activation chamber mixer speed control
 - c) VFD for control of MXR-5-1 speed.
 - 3) Panel lights functional including
 - a) Control panel power light
 - b) System run light
 - c) Alarm fault light for low water pressure, or low polymer flow
 - 4) LED display for neat polymer flow rate
 - f. Simulate a call to initiate Auto polymer solution makeup. Verify
 - 1) TW2 water valve on polymer makeup skid opens and admits water into activation chamber
 - 2) Polymer makeup skid neat pump initiates operation
 - g. Set temperature controls at TV-5-1 for delivery of TW2 water to the wetting head at a temperature of between 50 and 80 degrees F.
- 2. Manual Operational Mode
 - a. From LCP-5-1, verify manual operation of polymer preparation system including
 - 1) Polymer makeup solenoid valve actuation
 - 2) TW2 water delivery flow to polymer makeup unit
 - 3) Neat polymer pump on makeup skid functions
 - b. Set rates for speed control of polymer pump and activation chamber mixer
- 3. Automated Operational Mode
 - a. Upon confirmation that all components for polymer preparation equipment are functional, set the hand switch on LCP-5-1 for auto operation. Simulated a call to run from the Andritz panel. Verify sequence of automated operations against polymer preparation vendor equipment O&M manual.
 - b. Verify alarm functions by simulation of alarm conditions
 - 1) Low differential pressure between feed water and dilute polymer supply
 - 2) Low neat polymer pumped flow on polymer makeup skid
- H. Digested Sludge Pumping Overview

1. Digested Sludge Pumps P-1-1 and P-1-2 are
 - a. Duty redundant service.
 - b. Progressive cavity pumps
 - c. Configured with integral temperature sensors to detect high pump temperatures from operating with inadequate priming and/or insufficient fluid flow.
 2. Digested sludge pumps are controlled to operate from a signal originating in the Andritz Screw Press Control Panel.
 3. Local Control Panel LCP-1-1 to provide operator selectable control and alarm annunciation features defined further below.
- I. Digested Sludge Pumping Automation
1. Prior to running the pumps with fluid:
 - a. Confirm function of E-Stop Switch
 - b. Confirm function of LCP-1-1 disconnect switch
 - c. Inspect components within LCP-1-1 for consistency with approved panel shop drawings
 - d. Configure the pump VFDs in LCP-1-1 if not already done at factory
 - e. Enter recommended set point values for alarms in LCP-1-1 PLC
 - 1) High pumped discharge pressure
 - 2) High pump stator temperature
 - f. Simulate input pump run signal
 - 1) Bump and verify pump rotation for each pump. Do not run progressive cavity pumps dry
 - 2) Confirm run condition illuminates panel run light for that pump
 - g. Simulate high stator temperature signal to confirm pump de-energize control and alarm annunciation
 - 1) Confirm simulated alarm condition
 - a) Sends alarm fault signal to Andritz panel that de-energizes Screw Press operations
 - b) Illuminates panel alarm light for that pump
 - 2) Simulate high discharge pressure signal to confirm pump de-energize control and alarm annunciation
 - a) Sends alarm fault signal to Andritz panel that de-energizes Screw Press operations
 - b) Illuminates panel alarm light for that pump

2. Manual Operational Mode
 - a. Verify pipe system valves are set to direct digested sludge to the suction side of Pumps P-1-1 and P-1-2.
 - b. Select which pump is to run using Hand Switches HS-1-1 HOA and HS-1-2 HOA. Set the switch for the pump to operate in the Hand position and the standby pump in the Off position.
 - c. Verify
 - 1) Pumped flow is occurring using
 - a) Reported flow from FIT-1-1
 - b) Pump discharge pressure reported from PIT-1-2 or 2
 - 2) Run light for operating pump is illuminated green on LCP-1-1 panel front
 - 3) Manual speed control for operating pump available using speed control hand switch SKH-1-1 or 2
 - 4) Display of pumped flow and speed is displayed on OIT at LCP-1-1
 - 5) Alarm status light is off for pump selected to run.
 - 6) Pump stator temperature display on OIT at LCP-1-1
 - 7) Repeat verification of function and control for standby pump
3. Automatic Operational Mode
 - a. Decide on which pump to perform as duty and which is standby
 - b. Set Hand Switch for duty pump to Auto position
 - c. Simulate an input run signal to LCP-1-1
 - d. Simulate an input pumped flow signal to LCP-1-1
 - e. Verify
 - 1) Pumped flow is occurring using
 - a) Reported flow from FIT-1-1
 - b) Pump discharge pressure reported from PIT-1-2 or 2
 - 2) Run light for operating pump is illuminated green on LCP-1-1 panel front
 - f. Confirm pumped flow requested by input control signal is occurring as reported by FIT-1-1
 - g. Verify
 - 1) Display of pumped flow and speed is displayed on OIT at LCP-1-1
 - 2) Alarm status light is off for pump selected to run.
 - 3) Pump stator temperature display on OIT at LCP-1-1
 - 4) Repeat verification of function and control for standby pump

J. Wash Water Booster Pumping Overview

1. Non-potable washwater for the process is supplied by the City's potable distribution system. The potable enters the main process building and passes through a backflow preventer so that the water can be used for non-potable applications in the plant. The booster pump equipment increases the pressure of the city water and directs that water to the Screw Press equipment.
2. The booster pump skid consists of two duty-redundant pumps with VFDs. The pumps are energized when the pump skid's on-board pressure sensor detects a drop in the skid's discharge pressure due to water use by the screw press. One of the pumps energizes and varies the speed of the pump with the VFD to meet the downstream pressure setpoint defined in the booster pump control panel.
3. The pumps will shut down if the downstream pressure setpoint is met with the pumps operating at their minimum turndown speed.
4. Should two pumps be needed to meet set point pressure conditions, each pump delivers half of the pumped flow required.

K. Wash Water Booster Pumping Automation

1. Prior to initiating pumping operations, verify
 - a. All pump components are present
 - b. Power supply and plumbing connections to the booster pump skid.
 - c. Check that the air pre-charge in the on-skid diaphragm tank is 0.7 times the required discharge pressure. This must be conducted without the suction or discharge of the skid connected to the system pressure.
 - d. Configure the Control Panel LCP-3-1
 - 1) Select Service Language
 - 2) Select Display Units, SI vs US
 - 3) Set Time and Date
 - 4) Set Ethernet Comm
 - 5) Configure VFD settings
 - 6) Enter set point value of discharge pressure to be maintained by pump skid
2. On first startup, or after draining the booster pump skid, the system must be primed
 - a. Close all discharge manifold pump isolation valves and open all inlet manifold pump isolation valves
 - b. Open the vent plug on top of each pump. Air and water will escape from the pump through a small hole in the large vent plug. When the air is out and water is flowing steadily, close the vent plug.

3. Check the rotation of the pump and verify that it is spinning in the correct direction
4. Manual Operational Mode
 - a. Manual operational mode is possible by configuring the pump with the control panel but is not recommended for normal operation.
 - b. In manual operating mode, the controller allows individual pumps to operate independent of the Proportional Integral (PI) control algorithm programmed into the LCP-3-1 at the factory. Manual pump control is either in Max or Normal control mode.
 - 1) In Max (Manual) mode pumps individually run at a set point maximum speed
 - 2) In Normal (Manual) mode pumps individually run at a set point assigned speed.
 - c. To run the washwater pumps in manual mode without Screw Press operation, the W2 piping system must be temporarily disconnected from the Screw Press and discharged to drain.
5. Automatic Operational Mode
 - a. Automatic operational mode is normal operation for the washwater booster pump skid.
 - b. Pumps are called to run when the washwater solenoid valves at the Screw Press are opened and W2 washwater allowed to enter the Screw Press. The resulting decrease in pumped discharge static pressure results in the pump controller in LCP-3-1 to initiate operation of the duty pump at a speed as needed to meet the static discharge pressure set point value entered into the pump controller.
 - c. When the Screw Press washwater cycle is completed, its wash water solenoid valves close and the pumped discharge static pressure rises. This causes the pump speed to ramp down and eventually stop pumping until caused to run during the next Screw Press washwater cycle.
 - d. When washwater is being discharged, use the reading from Rotameter FI-2-1 on the suction side of the pump piping to check the washwater flow rate and adjust flow using Flow Control Valve FCV-2-1 adjacent to the rotameter.

END OF SECTION 40 90 00

SECTION 40 91 19.29 - PRESSURE MEASURING SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, functional test, and provide startup services for pressure measuring systems and related appurtenances, complete and functional with electrical and control systems, as specified herein and as shown on the Drawings.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. 01 10 00 – Summary
- C. 01 14 00 – Project Constraints
- D. 01 33 00 – Submittal Procedures
- E. 01 60 00 – Product Requirements
- F. 01 75 00 – Starting and Adjusting
- G. DIVISION 26 – Electrical
- H. 40 90 00 – Process Instrumentation and Controls

1.3 QUALITY ASSURANCE

- A. “Smart” transmitters shall be furnished when or whenever possible.
- B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL), Factory Mutual (FM), or other Nationally Recognized Testing Laboratory (NRTL) suitable to the State of Alaska.
- C. All parts and components shall be of a single manufacturer and designed as a single system.

1.4 SUBMITTALS

- A. Prepare, deliver, and process under provisions of Section 01 33 00 SUBMITTAL PROCEDURES. Requests for proposed substitute or “or-equal” equipment/systems/products will be considered in accordance with Section 01 25 00 SUBSTITUTION PROCEDURES.
- B. Complete list of all deviations from the Drawings and Specifications.

- C. Shop Drawings. Provide the following:
 - 1. Product data and cut sheets for make and model of components intended for use in the work.
 - 2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - 3. Installation, Operations and Maintenance manuals. Including Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.

PART 2 - PRODUCTS

2.1 PRESSURE INDICATOR (PI)

- A. Function: Pressure gauge with diaphragm seal to monitor and locally display pressure of pipe flow.
- B. Description: bourdon tube type, C-shape, 2½-inch diameter, stainless steel case, dry, black figures on white background aluminum dial, black pointer, safety glass window, ¼-inch NPT lower connection. Accuracy: ±1.0% full scale ASME B40.100, Grade 1A. Include NSF 61 certification and label.
- C. Manufacturers and Products:
 - 1. Trerice, 700 Series. Model 700B 25 02 L A 140.
 - 2. Diaphragm Seal: Aschcroft Inc 100 Series.

2.2 PRESSURE INDICATOR/TRANSMITTER (PIT)

A. Tag Numbers: PIT-1-1 and PIT-1-2. Digested Sludge.

1. Function: Monitor, Locally Display, and Transmit Pressure of the Digested Sludge on the discharge of the Digested Sludge Pumps.
2. Area Classification: Unclassified. Unless noted otherwise on a Code Analysis Drawing.
3. Instrument Type: Direct reading gauge static pressure
4. Characteristics:
 - a. Accuracy: $\pm 0.075\%$ of Span.
 - b. Dynamic Performance: 100 milliseconds.
 - c. Range: 0 to 150 psig.
 - d. Output: 4-20 mA with digital signal based on HART protocol.
 - e. Process Connection: 3-inch.
 - f. Diaphragm: 316 stainless steel.
 - g. Mounting Flange: 3-inch ASME B16.5 Class 150.
 - h. Seal Fill Liquid: Silicon 200. Temperature Limits: -49 to 401 °F.
 - i. Sensor module configuration: Gage, stainless steel flange adapter.
 - j. Sensor module diaphragm and sensor fill fluid: 316L stainless steel, silicone
 - k. O-ring: glass-filled PTFE.
 - l. Lower Housing Flushing: Ring material 316 stainless steel. Two ½-inch NPT flushing connections.
 - m. Housing: Polyurethane coated low-copper aluminum, NEMA 4X. Conduit Entry: ½-inch NPT.
 - n. Electrical Connections: ½-inch NPT.
 - o. Local Display: LCD with PSIG Units.
 - p. Power Supply: 24 VDC +/-10 percent.
5. Manufacturer and Model Numbers: Emerson, Rosemount.
 - a. Instrument: Model 2051L 4 A A 0 F D 1 1 A A M4 F8

2.3 ISOLATION VALVES

- A. See specification Section 40 05 50 PROCESS VALVES AND OPERATORS.

PART 3 - EXECUTION

3.1 GENERAL

- A. Pressure measuring and control systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested according to Section 40 90 00 PROCESS CONTROL AND INSTRUMENTATION SYSTEMS.

3.2 INSTALLATION

- A. Instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 40 PROCESS INTERCONNECTIONS, as shown on the Drawings, and per the Manufacturer's instructions.
- B. Supports: Provide all hangers, supports, guides, anchors, bolts, and mounting accessories as required for the installation.
- C. Isolation Valves: All instrument mounting nipples and sensing lines shall be provided with isolation valves at the pipe tap.
- D. Instrument Manifolds: All pressure transmitters shall be provided with instrument manifolds for testing and calibration. All manifolds shall be independently supported.

END OF SECTION 40 91 19.29

DIVISION 41

MATERIAL PROCESSING AND HANDLING EQUIPMENT

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SECTION 41 12 13.36 SCREW CONVEYOR

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, functional test, and provide startup services for one shaftless screw conveyor and related appurtenances, complete and functional with electrical and control systems, as shown on the Drawings and as described herein.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. 01 10 00 – Summary
- C. 01 33 00 – Submittal Procedures
- D. 01 43 33 – Manufacturer's Field Services
- E. 01 60 00 – Product Requirements
- F. 01 75 00 – Starting and Adjusting
- G. 09 90 00 – Painting and Coatings
- H. DIVISION 26 – Electrical
- I. DIVISION 40 – Process Interconnections
- J. 40 05 01 – Process Piping
- K. 40 05 50 – Process Valves and Operators
- L. 40 90 00 – Process Instrumentation and Controls

1.3 QUALITY ASSURANCE/REFERENCES

- A. Single source responsibility: All equipment, instruments, and other products specified in this Section for each piece of equipment shall be furnished by one supplier.
- B. Manufacturer's Qualifications:
 - 1. Minimum 15 years' experience in production of equipment substantially similar to the specified equipment.
 - 2. Manufacturer's shop welds, welding procedures, and welders shall be qualified and certified in accordance with the requirements of ANSI/AWS D1.1.

- C. Equipment shall, as applicable, meet the requirements of the most recent version of the following industry publications, standards, regulations, and requirements as may be referenced in this Section and the Contract Documents:
1. American Gear Manufacturers Association (AGMA)
 2. American Institute of Steel Construction (AISC)
 3. American Iron and Steel Institute (AISI)
 4. American Society of Testing and Materials (ASTM)
 - a. A322: Carbon and Alloy Steel Bar Specifications.
 - b. A507: Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled
 5. American Welding Society (AWS)
 - a. A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination
 - b. B2.1 Specification for Welding Procedure and Performance Qualification
 - c. D1.1 Structural Welding Code, Steel
 - d. D1.6 Structural Welding Code Stainless Steel
 - e. D1.8 Structural Welding Code – Seismic Supplement
 - f. QC1 Standard for AWS Certification of Welding Inspectors
 6. American Structures Painting Council (ASPC) Publications
 7. Anti-Friction Bearing Manufacturers Association (AFBMA) Publications:
 - a. Standard 9-90 Load Ratings and Fatigue Life for Ball Bearings.
 - b. Standard 11-90 Load Ratings and Fatigue Life for Roller Bearings
 8. Conveyor Equipment Manufacturers Association (CEMA) standards
 9. National Electrical Manufacturer's Association (NEMA) Standards
 10. National Electrical Code (NEC)
 11. Underwriters Laboratory (UL and cUL)
 12. Factory Mutual (FM)
 13. International Building Code (IBC) Seismic loading and bracing as amended by the City of Kenai.
- D. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1 Structural Welding Code, Steel
2. AWS D1.6 Structural Welding Code Stainless Steel
3. AWS D10.4 Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing

1.4 SUBMITTALS

- A. Prepare, deliver, and process under provisions of Section 01 33 00 SUBMITTAL PROCEDURES. Requests for proposed substitute or “or-equal” equipment/systems/products will be considered in accordance with Section 01 25 00 SUBSTITUTION PROCEDURES.
- B. Complete list of all deviations from the Drawings and Specifications.
- C. Shop Drawings: Provide the following:
 1. Certification that field measurements have been verified prior to drawing release.
 2. Certification of the floor surface and mounting requirements of conveyor support legs and base plates.
 3. Certification that building steel shapes and sizes have been verified and coordinated with the equipment provided herein prior to drawing release.
 4. Previous installation list. Installations shall be only those in the United States. Information submitted shall include but not be limited to:
 - a. Name and location of installation. Name, address, and phone number of person in direct responsible charge.
 - b. Month and year the equipment was placed in operation.
 - c. Brief description of equipment.
 5. Complete catalog information, descriptive literature, catalog cut sheets, complete set of dimensional drawings, specifications, and identification of materials of construction.
 6. Make, model, weight, horsepower, and power requirements for each equipment assembly.
 7. Complete motor nameplate data, as defined by NEMA, motor manufacturer, including any motor modifications, and including proof of third party listing (e.g. UL, FM).
 8. Location and orientation of piping and chute interconnections.
 9. Screw diameter, pitch, rotational speed, torque tube diameter.
 10. Conveyor torque requirement calculations.
 11. Torque calculations for the gear reducer and reducer motor.
 12. Horsepower calculations for the drive motor(s).

13. Screw strength calculations for spring (screw) compression and elongation showing the supplied screw meets or exceeds spring effect intent.
14. Complete schematic diagrams for electrical control panel(s).
15. Factory finish systems.
16. Special shipping, storage, and protection and handling instructions.
17. Seismic structural and anchorage calculations and details stamped and sealed by a Professional Engineer registered in the state of Alaska.
18. Information on equipment field erection requirements including weight of assembled components, weight of each subassembly and critical dimensions, fasteners and anchors.
19. Manufacturer's printed Installation, Operations, and Maintenance (IOM) instructions and recommendations for all equipment and appurtenances.

D. Quality Control. Provide the following:

1. Product Information Forms per specification Section 01 60 00 PRODUCT REQUIREMENTS.
2. Functional test and results of performance confirmation checks per specification Section 01 75 00 STARTING AND ADJUSTING and required by this specification.
3. Operation and Maintenance Manuals per the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, and include:
 - a. Contact information for support of equipment operation and/or maintenance
 - b. Safety precautions and procedures.
4. Per specification Section 01 43 33 MANUFACTURER'S FIELD SERVICES, provide the following to CONTRACTOR for submittal to the OWNER:
 - a. Manufacturer's Certificate of Proper Installation and Operation of the equipment and systems of this section.
 - b. Manufacturer's Certificate of Training:

1.5 MANUFACTURER'S SERVICES

- A. A manufacturer's representative for the equipment system specified herein shall be present at the job site for two (2) days duration NOT including travel time (this will consist of two separate trips for a total of two days spent on site), the first trip is intended for initial onsite installation assistance, inspection, and verification of installation. The second trip is intended to perform final functional and performance testing, start-up and job-site training. The schedule of the trips will be coordinated with OWNER.

- B. The Manufacturer's Representative shall be a direct employee of the Manufacturer, or a Manufacturer's trained specialist experienced in the installation of the specified systems and with at least five (5) years of field experience.
- C. A Manufacturer's Certificate of Proper Installation and Operation, and Training are required for work under this section.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Control components shall be protected from corrosion during shipping and storage.
- B. Ship and store equipment with corrosion-inhibitor systems as recommended by the equipment manufacturer.
- C. Protect equipment during shipping from saltwater spray and freezing as recommended by the equipment manufacturer.
- D. Store equipment in clean, dry, well-ventilated area. Protect equipment from freezing and provide heated storage areas as recommended by the equipment manufacturer.
- E. Cover panels and other control elements to protect from dust during construction.

1.7 WARRANTY

- A. The supplier shall guarantee in writing that the equipment furnished is appropriate for the intended service and shall be free of manufacturing and fabrication defects in material and workmanship for a period of 1 year after the equipment is satisfactorily placed in service. If the equipment is not placed in service within 6 months of delivery, the 1-year guarantee period shall commence 6 months after delivery.

PART 2 - PRODUCTS

2.1 GENERAL

- A. CONTRACTOR shall be responsible for:
 - 1. Coordination of equipment dimensions, weights and loadings with the listed Manufacturers and the incorporation of the selected equipment into the dimensional constraints of the site or building, within the limits of the structural and architectural concrete and steel, piping and equipment arrangement, and of other features and systems as shown on the Drawings.
 - 2. Modification of appurtenant equipment and piping to accommodate Substitute and "Or-Equal" equipment. CONTRACTOR shall notify OWNER of modifications necessary to accommodate Substitute and "Or-Equal" equipment and shall submit for review and approval the proposed modifications.
 - 3. Electrical power and automated process control work associated with the installation of wiring of the conveyor belt and appurtenances.

- B. The Contract Documents indicate specific required features of the equipment supply and systems, but do not purport to cover all details of design and construction.

2.2 ELECTRICAL

A. Third Party Listings

1. Third party certification, listing and labeling shall be provided per the regulations of the State of Alaska for equipment, systems, assemblies and panels where standards exist; and for controls and instrumentation; electrical drivers; and appurtenant electrical components. Approved third party certifiers include Underwriters Laboratories (UL), Factory Mutual (FM) and others approved by the State of Alaska. Use listed materials in the work according to the criteria for these listings.
2. All equipment control panels shall be furnished with an Underwriters Laboratory label. The label shall represent approval under UL 508 Industrial Control Panels. All materials used in control panel fabrication shall be listed according to the criteria for UL 508 listing.

B. Code Conformance and Compliance

1. All work will be configured and assembled in accordance with applicable electrical codes observed in the United States and Alaska at the time the equipment is fabricated. Codes that apply include the National Electric Code, the National Electrical Contractor's Association Standards and other codes may apply as appropriate to the Work.
2. System, controls and instrumentation, and electrical drivers. Meet requirements for class, group, and division location in accordance with NFPA 70 and NFPA 820.
3. Manufacturer shall verify equipment to be shipped to job site conforms to NEC/NFPA requirements and meets the State of Alaska third party listing and labeling requirements. Equipment not meeting the requirements of this specification shall be replaced with equipment compliant with this specification, or be certified by a third party inspector at the Manufacturer's expense.

2.3 DESIGN/CONSTRUCTION REQUIREMENTS

- A. Provide systems, equipment, and components, including supports and anchorages, in accordance with the provisions of the most current version of the International Building Code (IBC) as amended by the City of Kenai.
- B. Seismic Restraint, Load and Design: Per the requirements detailed on the Structural drawings.
- C. All welds, and sharp corners of cut and sheared edges shall be ground and polished smooth and passivated. See passivation requirements of paragraph FACTORY/SHOP SURFACE PREPARATION AND COATING.
- D. All welds to be continuous unless otherwise specified. Facing surfaces of field-welded components shall be beveled and match marked.
- E. Area Classification: Unclassified. Unless noted otherwise on a Code Analysis Drawing.

2.4 SHAFTLESS SCREW CONVEYOR

- A. Tag Number: SC-4-1
- B. The enclosed Shaftless Screw Conveyor shall be suitable for conveying dewatered sludge cake from a screw press and discharging into a common dumpster, and shall include trough, liners, covers, screw, chutes, electric motor with gear reducer, mounting/support structure, safety accessories, and control system.
- C. Manufacturer and Model:
 - 1. Spirac USA, Inc. SPIRAC® U-trough, Model U250-SPX/SS. The wear liner shall be SPIRAC Duraflo SPX.
 - 2. Requests for proposed substitute or “or-equal” equipment/systems/products will be considered in accordance with the requirements of this specification, Section 01 33 00 SUBMITTAL PROCEDURES, and 01 60 00 PRODUCT REQUIREMENTS.
- D. Number - 1
- E. Design Criteria:
 - 1. Minimum Capacity, cubic foot/hour - 35
 - 2. Approximate Length, feet - 18
 - 3. Nominal Outside Screw Diameter, inch - 7¾
 - 4. Screw Pitch, inch - 5½
 - 5. Approximate Installation Angle, degrees - 30
 - 6. Transport direction. - pull

2.5 SHAFTLESS SCREW

- A. Screw flighting for the shaftless screw conveyors shall be designed to convey material without a center shaft or hanger bearings.
- B. Screw flights shall be formed from corrosion resistant HTMAS (High Tensile Micro Alloy Steel), and shall be concentric to within +/- 2mm.
- C. Screw shapes shall be cold formed from continuous bar, in two distinct stages, in order to achieve optimum hardness.
- D. For increased efficiency, a second, inner screw, concentric with the outside screw shall also be provided.
- E. Screw strength calculations shall show the torsional rating of completed screw exceeds the torque load produced within the trough at 150% of the design load.

- F. Screw deformation calculations shall be based on the formula for cylindrical helical springs of rectangular cross section found in the latest edition of Marks' Standard Handbook and shall demonstrate "spring effect" of the completed screw does not exceed +/- 1/8-inch per linear foot of screw under conditions of 100% trough fill.
- G. Minimum outer spiral thickness: 3/4-inch.

2.6 SCREW WELDING

- A. Screw flighting shall have full penetration welds at all splice connections, to present a continuous and complete screw upon installation.
- B. Field welds at the jobsite by the installer may be necessary when any overall conveyor length presents shipping or handling constraints.
- C. When welding screw sections in the field during installation, the installing contractor shall be provided with complete instructions from the screw manufacturer. Screw ends requiring field welding, shall be prepped and match marked by the screw manufacturer prior to delivery.

2.7 SCREW MOUNTING

- A. The driveshaft with integral coupling disc, shall penetrate the end plate through a guarded, serviceable, gland packing housing prior to insertion to the gear reducer. The coupling disc shall be machine faced after fabrication, to include centering hub for screw mounting and alignment.
- B. The connection of the screw to the drive system shall be through fastening of the driveshaft and screw coupling discs. Fasteners shall be readily accessible and of a corrosion resistant high strength material.
- C. The screw coupling plate, shall be reinforced with a welded gusset, shaped and formed to provide a transition of load forces from the plate to the screw. Connections which use torsion arms with point load connections to the screw shall not be acceptable.
- D. The drive shaft assembly shall incorporate a grease lubricated labyrinth seal, serviceable from the exterior of the conveyor, which is shaft mounted internally between the back plate and screw coupling connection.

2.8 HORIZONTAL AND INCLINED TROUGHS (LESS THAN 35 DEGREES)

- A. U-shaped troughs shall be formed of sheet or plate, similar to the dimensional standards of CEMA 300 and to CEMA enclosure classification IIE.
- B. Troughs shall be constructed with formed upper faces integral to the body of the trough, in order to provide optimum sealing of the gasketed connection between lid and trough.
- C. Troughs shall be flange-joined when any section exceeds 24-feet in length.
- D. On inclined conveyors, a drain outlet shall be integral to the conveyor trough, in order to facilitate cleaning. Drain outlet shall be located as shown on the Drawings.

- E. Each trough shall be equipped with inlet and/or discharge openings as shown on the Drawings. If required, each inlet and discharge opening shall be flanged suitable for interconnection to other devices. Any interconnecting devices such as chutes or hoppers shall be fabricated from the same grade of material as the troughs and with a gauge thickness to suit the application requirements.
- F. Bolted covers shall be furnished for any portion of trough that is not covered by the filling chute. Covers shall be manufactured in maximum five (5) foot lengths to allow for ease of access during replacement of the (shorter) sectioned wear liner.
- G. Inlet and discharge hoppers or chutes shall be provided of the same construction material as the conveyor troughs, as shown on the Drawings. Flanges shall be a minimum 0.25" thick.
- H. Safety Labelling shall be CEMA severe duty style, appropriate for the equipment, and affixed at the factory. In addition to warning of operation without covers, all warning labels shall include a callout for lockout of power before servicing.

2.9 REPLACEABLE WEAR LINER

- A. Conveyor troughs shall be lined with ultra-high molecular weight polyethylene (UHMW-PE) based material, which has been specifically modified for the reduced friction and wear requirements of the application.
- B. Wear liner shall be supplied in maximum 4-foot sections to ease of replacement during servicing.
- C. Each section of liner shall be a single piece, formed and bonded with two (2) layers of the same material, each of a different color, to provide a visible indication when the liner is nearing the end of its useful life.
- D. The liner shall be held in place with stainless steel cleats, permanently welded to the inside of the trough.
- E. Liner thickness shall be 5/16-inch. The wear indicating color shall be at least 1/8-inch thick.

2.10 DRAIN VALVE

- A. Provide 3-inch ball valve as a drain valve for the lower end of the screw conveyor trough. Valve tag to be FV-4-1. See Section 40 05 50 PROCESS VALVES AND OPERATORS.

2.11 CONVEYOR SUPPORTS

- A. Conveyor shall be furnished complete with stainless steel structural plate and shapes supports of minimum ¼-inch thick, suitable for mounting as shown on the Drawings.
- B. Supports shall be fabricated, assembled and fit to the conveyor prior to its delivery to the jobsite. Supports and conveyor segments shall be clearly match marked by the Manufacturer, for ease of installation by the CONTRACTOR.
- C. For design of floor supports with imbedded anchors, manufacturer shall allow for up to 1 inch of grout beneath each support foot pad for CONTRACTOR to compensate for uneven floor elevations.

- D. All braces and hanging supports furnished by the Manufacturer shall be up to 6-inches longer than required for field fit and levelling by the CONTRACTOR during installation.
- E. Conveyor floor and hanging support, anchoring fasteners, and bracing shall be coordinated and designed with CONTRACTOR, and located along the conveyor trough so as to avoid interference with other equipment, site features, or equipment supports.

2.12 GEAR REDUCTION UNIT

- A. Gears shall be AGMA Class II, single or double reduction, constant speed gear reduction units, with high capacity roller bearings.
- B. Bearings shall be designed for the thrust loads of the application, and shall have a minimum Bearing Service Life L_{10} of 30,000 hours (or L_{50} of 150,000 hours), as defined by the American Bearing Manufacturers Association (ABMA).
- C. Manufacturer shall provide bearing service life calculations compiled by the gear reducer supplier. Results shall be based on the specific design load of the application, as calculated by Manufacturer.
- D. The reducer will be air-cooled unit with no auxiliary cooling requirement. The gear reducer shall be sized with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate at the driven shaft speed, whichever is greater.
- E. Conveyor gear reduction units shall be powered by direct coupled motors.
- F. Drives shall be completely supported by direct mounting to a dual flanged bellhousing adapter, providing connection to the drive end plate of the shaftless screw conveyor.
- G. Bellhousing adaptors shall set off the drive from the trough, in order to allow seepage of any material from the conveyor trough to atmosphere rather than onto the output seal of the gear reducer/ motor drive unit.
- H. The drive unit mounting to the end of the trough shall require no additional supports, and there shall be no visible "wobble" movement under any operating condition.
- I. To allow for system upset, the drive system shall be designed at a minimum, to operate the conveyor with a trough filled to 1.5x the theoretical design load.

2.13 DRIVE MOTORS

- A. Motor shall be 460 volt, 60 Hz, 3 phase, compliant with the motor specification and rated for the operational area noted in the Drawings.
- B. Motors shall be of energy efficient design meeting or exceeding the most current edition of NEMA MG1-Table 12-10.
- C. Motors shall have a 1.15 nameplate service factor, a 0 enclosure, and be designed with torque characteristics in accordance with NEMA MG1-12.35 and 12.38.

2.14 ELECTRICAL ACCESSORIES

- A. Electrical items shall conform to the applicable standard of the National Electrical Manufacturers Association (NEMA) and the National Electrical Code (NEC). Both power and control equipment shall be insulated for not less than 600 volts even though operating voltages may be lower.
 - 1. Tsubaki Shock Relay (supplied by conveyor manufacturer if they are supplying controls) The shock relay shall have an adjustable current level and shock time shall be adjustable from 0.2 seconds to 10 seconds. The shock relay shall have a push button to reset the shock relay after a current overload.
- B. Motion (Rotation) Sensor Probe. A non-contacting rotation sensor shall be lid or trough mounted on the conveyor, away from the drive. Sensor shall be rated for the environment of the application and shall not require a trough penetration for proper operation. Sensor shall be a model MSP-12 by Siemens Milltronics. Or approved equal.
- C. Motion (Rotation) Failure Alarm Unit. Each probe shall be provided with a motion failure alarm controller, to report screw or drive shaft failure. The Motion Failure Alarm shall be housed in an enclosure suitable for the environment. The unit shall be a model MFA-4P by Siemens Milltronics. Or approved equal.
- D. Emergency Pull Cord Switch.
 - 1. Conveyor shall be furnished with emergency pull cords. The cords shall activate a dual relay, trough mounted emergency stop switch, intended to provide a signal to immediately stop the conveyor, and any feeding devices, when activated.
 - 2. Pull cords shall run the full length of the conveyor in a straight path, guided through eyebolts spaced on not greater than 12-foot centers. Cording shall be orange colored, nylon coated, corrosion resistant safety cabling.
 - 3. The pull cord switch shall be housed in an enclosure suitable for the environment. The unit shall be a model RS by Conveyor Components Company. Or approved equal.

2.15 CONTROL PANEL LCP-4-1

- A. Provide control panel meeting requirements of industrial control panel specifications identified elsewhere in these Project specifications.
- B. Control panel features to include the following:
 - 1. Disconnect Switch
 - 2. Screw conveyor SC-4-1 gearmotor reversing motor starter and overload protection equipment
 - 3. Panel Lights
 - a. Panel Indicator Lights
 - 1) Panel Control Power – White when Energized

- 2) Screw Conveyor Energized – Green
- 3) Screw Conveyor Alarm Condition - Red
- b. E-Stop and Emergency Shut Down
 - 1) Provide mushroom push button for emergency stop of Screw Conveyor SC-4-1.
 - 2) Provide emergency shut down for Screw Conveyor SC-4-1 when pullcord is engaged
- c. Panel HOA Switch
 - 1) Hand switch position is for control of Screw Conveyor SC-4-1 from Local Control Panel LCP-4-1
 - 2) Off switch position de-energizes operation of Screw Conveyor SC-4-1.
 - 3) Auto switch position enable operation from Andritz control panel. See Functional Narrative in Specification Section 40 90 00.
- d. Panel Hand Switch for Forward, Off, Reverse rotational direction for screw auger.
- e. Purge timer
 - 1) The controls shall include an adjustable 0 – 30 minute timer that will allow a purge cycle, then automatically shut off the conveyor(s) after the equipment that supplies the conveyed material stops or drops it's run command.
- f. Torque shock timer, previously described herein.

2.16 SPARE PARTS

- A. All Spare Parts shall be provided in protective packaging for long-term storage.
- B. Manufacturer shall clearly identify and furnish any special tools required for routine service and maintenance of the equipment. Special Tools shall be provided in packaging designed for storage and repeated use.
- C. The following spare parts shall be supplied, as a minimum:
 1. One (1) Packing gland set, for each conveyor supplied
 2. One (1) complete set of liner for all conveyors if the second color of the liner is not the same material as the base liner.
- D. Conveyors shall be supplied by the manufacturer fully and completely lubricated and ready to be placed into operation. No spare lubricant shall be required for the gear reduction units within the warranty period.

2.17 CONVEYOR HOPPER AND DISCHARGE CHUTE

- A. Furnish screw conveyor with inlet and discharge hoppers and chutes of the same gauge and construction material as the conveyor troughs, at locations as shown on the Drawings. Flanges shall be a minimum 5-mm thick.
- B. Coordinate with Screw Press equipment Manufacturer for proper transition to screw conveyor from screw press.
- C. Furnish two-ply flanged discharge skirts (boots) to guide sludge cake into the Roll-off Dumpster. The flexible skirts (boots) shall be neoprene blend fabric reinforced, IM-950 by American Biltrite. Or approved equal.

2.18 FACTORY/SHOP SURFACE PREPARATION AND COATING

- A. Electric motors, speed reducers, and other self-contained or enclosed components shall have manufacturer's standard enamel finish.
- B. Stainless steel and other corrosion-resistant surfaces shall not be coated.
- C. The screw shall be furnished with one coat of shop primer only.
- D. All iron and mild steel surfaces to be painted shall be dry abrasive blasted in accordance with SSPC-SP6. Immediately coated with a minimum of one (1) coat of epoxy primer to prevent rusting and surface discoloration. Provide a total minimum dry film thickness of 3 mils prior to shipment to jobsite. Primer shall be compatible with the paint system specified for the equipment under paragraph FIELD FINISHING AND TOUCHUP. Finish coats shall be applied at the jobsite by CONTRACTOR.
- E. Stainless steel surfaces shall be cleaned with mild abrasive wheels and/or nonferrous blast media to remove heavy scale and weld spatter.
- F. Stainless steel equipment, after fabrication and cleaning, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion. Submerge all stainless steel components and structures in a chemical bath of nitric acid and hydrofluoric acid to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, wash the equipment with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer that is critical to the long life of the stainless steel.

2.19 ACCESSORIES

- A. Equipment Identification Plates:
 - 1. The manufacturer or supplier of the equipment shall identify each unit of equipment with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, electrical specifications, equipment capacity, supplier's name and location.

2. A 16-gauge stainless steel identification plate shall be securely mounted on the equipment in a readily visible location. The plate shall bear the ¼-inch die-stamped equipment name and identification tag numbers indicated in this Specification and shown on the Drawings.

B. Anchor Bolts:

1. Equipment Manufacturer/CONTRACTOR shall furnish required anchor bolts of size and strength required to securely anchor each item of Manufacturer's equipment, consistent with the Seismic requirements of the project.
2. Anchor bolts, hex nuts, and washers shall be stainless steel Type 316 stainless steel, wedge or epoxy type.
3. Anchor bolts shall be set by the CONTRACTOR. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

2.20 LUBRICANTS

- A. Screw Conveyor shall be supplied by the Manufacturer lubricated and ready to be placed into operation. No spare lubricant shall be required for the gear reduction units within the warranty period.

2.21 SPARE PARTS AND SPECIAL TOOLS

- A. Manufacturer shall clearly identify and furnish any special tools, and provide the following spare parts:
 1. One (1) Packing gland set
 2. One (1) complete set of liners.
- B. All Spare Parts shall be provided in protective packaging for long-term storage.
- C. Special Tools shall be provided in packaging designed for storage and repeated use.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Contractor shall verify equipment provided to the job site conforms to NEC/NFPA requirements and meets the State of Alaska third party listing and labeling requirements.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in undamaged condition, in Manufacturer's original container or packaging, with identifying labels intact and legible.

- B. Unload products in accordance with Manufacturer's instructions. Record the receipt of products at the site.
- C. Inspect for completeness and evidence of damage during shipment. Remove damaged products from the site and expedite delivery of identical new undamaged products and remedy incomplete or lost products to provide specified products so as not to delay the progress of the Work.
- D. Handle and store products in accordance with the Manufacturer's instructions. Store delivered products at the Wastewater Treatment Plant where directed by OWNER.
- E. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60-degrees F. Protect electrical, instrumentation, and control products, and insulation against moisture, water, and dust damage.
- F. Store fabricated products aboveground, on blocking or skids, and prevent soiling or staining. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- G. Store finished products that are ready for installation in dry and well ventilated areas.

3.3 INSTALLATION

- A. Install in accordance with Manufacturer's written instructions.
- B. Install equipment anchors, supports, and seismic bracing per the requirements of the Manufacturer, as indicated on Drawings, and consistent with the Seismic requirements of the project.
- C. Prior to assembly all stainless steel bolts and nut threads shall be coated with a non-seizing compound by the Contractor.
- D. Anchor Bolts: Accurately place using equipment templates.
- E. Support and securely anchor equipment and appurtenances. Process connections shall be plumb and tight.
- F. CONTRACTOR shall rely on Manufacturer for installation and startup assistance.
- G. CONTRACTOR shall coordinate scheduling of Manufacturer trip to the jobsite in Kenai, Alaska with OWNER and Manufacturer.
- H. Install electrical power circuits, instrumentation and control wiring and associated raceways as shown on the Drawings and required by Division 26 ELECTRICAL.
- I. Install all control and electrical equipment as per the manufacturer's recommendations and to provide operation as described in Section 40 90 00 PROCESS INSTRUMENTATION AND CONTROLS, and as shown on the Drawings.
- J. Prior to start-up of the facility, inspect, test, and document that the electrical and control systems are operational.

- K. Calibrate components including but not limited to: analog devices, discrete devices, controllers, I/O modules, and switches.
- L. Upon completion of installation and prior to equipment functional and performance testing, CONTRACTOR shall thoroughly clean structures, equipment, pipe, and related appearances free of all construction debris, trash and other materials that may be detrimental to the operation equipment in this specification.

3.4 FIELD QUALITY CONTROL

A. Functional and Performance Testing:

1. Equipment shall not be energized, or “bumped” to check the electrical connection for motor rotation without the Manufacturer’s service engineer present.
2. The Manufacturer’s service engineer shall make all necessary adjustments and settings to the controls, and in particular, verify the correct operation of screw conveyor.
3. Conduct on conveyor under actual or approved simulated operating conditions.
 - a. Test for a continuous 3-hour period without malfunction.
 - b. Verify correct operation of all control and alarm functions.
 - c. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - d. Operating Temperatures: Monitor bearing areas on equipment and motor for abnormally high temperatures.
4. Test Log: Record the following:
 - a. Horsepower requirements.
 - b. Driving motor voltage and amperage measured for each phase.
 - c. Function of Emergency Shutdown

3.5 RECORD DRAWINGS

- A. CONTRACTOR shall maintain a current set of construction drawings and specifications that reflect any changes, modifications, clarifications, additions, or deletions from the Contract Documents per specification Section 01 78 39 PROJECT RECORD DOCUMENTS. Annotations shall include any CONTRACTOR issued equipment or wiring identification tags and/or numbers. Record drawing information shall be provided to the OWNER at the completion of system start up and substantial completion.

3.6 MANUFACTURER'S SERVICES

- A. Installation Inspection: Prior to system start up, the Equipment Supplier shall inspect the installation of the equipment including instrumentation, and control and power wiring to verify system installation is satisfactory for operation.
- B. Startup Services: The Equipment Supplier shall provide a technical representative to the project site to observe the startup of the equipment, make adjustments to the equipment, and troubleshoot problems with the equipment as needed.
 - 1. Operator Training: The Equipment Supplier shall provide a minimum of 4 hours of training at the project site to review the Operations and Maintenance (O&M) Manuals for the project with the operations personnel.
 - a. O&M Manuals used for the training must have prior approval by OWNER through the submittal process prior to use in the training.
 - b. Equipment Supplier to provide OWNER signatures of operators attending the training certifying they have completed the training provided for the project.
- C. Notify OWNER and Manufacturer in writing, 10-days prior to the date when the installation will be ready for inspection.

3.7 TROUBLESHOOTING SERVICES

- A. If equipment and system do not meet manufacturer's published performance ratings or the requirements of this specification, CONTRACTOR and Manufacturer/Manufacturer's Representative shall provide troubleshooting services to identify the cause of the problem and correct the problem.
- B. If performance problems are due to defects in the work installed by the CONTRACTOR, CONTRACTOR shall correct the defective work at no cost to OWNER.
- C. If equipment does not meet performance requirements due to material or workmanship defects in the equipment, CONTRACTOR shall, with the assistance of the Manufacturer/Manufacturer's Representative for that equipment, identify the fault and recommend repair and/or replacement of the faulty component or components to OWNER at no cost to OWNER.

3.8 FIELD FINISHING AND TOUCHUP

- A. Provide field finishing and touchup as recommended by the Manufacturer.
- B. Exterior Coating, appurtenances and equipment provided with Manufacturer's primer or factory-finished exterior coating.

Surface Prep.	Coating	Min. Coats, Cover
Detergent Wash, Fresh Water Rinse, brush blast if primer is aged, and in Accordance with the Manufacturer's Directions (as required)	Aliphatic Polyurethane	2 coats, 3 MDFTPC

3.9 FINAL CLEAN

- A. Clean surfaces in accordance with Manufacturer's written instructions.

END OF SECTION 41 12 13.36

SECTION 41 22 13.19 – JIB CRANES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes all crane components to assemble and operate a 1/2-ton capacity floor mounted jib crane, complete with baseplate and chain operated low headroom trolley hoist.
- B. Related Requirements:
 - 1. Section 01 60 00 - Product Requirements
 - 2. Section 03 30 00 - Cast-in-Place Concrete

1.2 REFERENCES

- A. American Institute of Steel Construction (AISC) - Manual of Steel Construction, Part 5, Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
- B. American National Standards Institute (ANSI):ANSI B30.11 - Monorails and Underhung Cranes.
- C. ASTM International (ASTM):
 - 1. ASTM A36 - Carbon Structural Steel.
 - 2. ASTM A325 - Structural Bolts, Steel, Heat Treated, 120/150 ksi Minimum Tensile Strength.
 - 3. ASTM A490 - Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
 - 4. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
- D. American Welding Society (AWS) D1.1 - Structural Welding Code.
- E. Occupational Safety and Health Administration (OSHA) - Specification 1910.179 - Overhead and Gantry Cranes.

1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Describe capacities, performance, operation, and applied forces to foundation.
 - 2. Preparation instructions and recommendations.

3. Storage and handling requirements and recommendations.
4. Installation methods.
- B. Shop Drawings: Shop drawings showing configuration, dimensions, service area, and construction and installation details.
 1. Shop Drawings shall indicate the sizes of the job crane components as well as the anchor bolt position, diameter, and grade.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in designing and manufacturing cranes with 25 years successful experience.
- B. Installer Qualifications: Company experienced in assembly and installation of cranes with 5 years successful experience and acceptable to crane manufacturer.
 1. Perform welding by certified operators in accordance with AWS D14.1.
 2. Bolted connections shall be in accordance with torque tightening procedures specified in AISC Manual, Part 5.
 3. Clearly label crane with rated load capacity. Place label at height and location easily read from floor level and loading position.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.7 WARRANTY

- A. Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace assemblies and components that fail in materials and workmanship within warranty period from date of Substantial Completion.
 1. 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Advantage Cranes.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00 - Substitution Procedures and Section 01 60 00 - Product Requirements.

2.2 JIB CRANES

- A. Performance:
 - 1. Crane shall be designed, fabricated, and installed in accordance with ANSI B30.11 and OSHA 1910-179.
 - 2. Crane shall be designed for minimum effort manual rotation.
 - 3. Boom shall not drift when at rest.
 - 4. Maximum deflection at boom end: 1/150 span based on capacity plus 15 percent for hoist and trolley weight.
 - 5. Crane shall be designed to withstand the following:
 - a. Live load capacity equal to net rated hook load: 1/2 ton.
- B. Mast Type Jib Crane: Crane shall consist of floor-supported, top-stabilized steel beam mast connected to 360 degree rotating steel beam boom covering circular work area.
 - 1. Acceptable Manufacturer and Model:
 - a. Model L11012 as manufactured by Advantage Cranes.
 - 2. Construction: Fabricate from ASTM A36 steel sections with finished ends and surfaces.

2.3 TROLLEY MOUNTED HOIST

- A. Performance
 - 1. The trolley mounted hoist shall be able to slide freely on the job boom and have a lifting capacity not less than the Jib crane.
 - 2. The hoist shall have a minimum headroom distance of 6" from the bottom of the jib boom to the top of the picking hook to allow for maximum lift height.
 - 3. The trolley shall have wheels designed to fit both tapered and flat flange beams with sealed bearing that offer smooth movement with low friction.

- B. Ultra Low Headroom Type Hoist
 - 1. Acceptable Manufacturer and Model:
 - a. Harrington SHB Ultra Low Headroom Manual Trolley 1- Ton

2.4 SHOP FINISHING

- A. Steel: Steam wash steel crane components with iron phosphate solution and apply yellow baked enamel finish.
- B. Provide spray can of matching color, air-drying paint for field touch-up.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until support structures have been properly prepared.
- B. Design and construction of reinforced concrete footings and slabs as detailed on Drawings and specified in other sections. Verify that accurate crane applied forces and anchor bolt patterns are provided for foundation design.

3.2 INSTALLATION

- A. Install units and accessories in accordance with manufacturer's instructions and approved shop drawings. Do not modify crane components in any manner without advance written approval by crane manufacturer.
- B. Clearances for Moving Crane Components:
 - 1. 3 inches (76 mm) minimum vertical clearance from any overhead obstruction.
 - 2. 2 inches (51 mm) minimum horizontal clearance from any lateral obstruction.

3.3 FIELD QUALITY CONTROL

- A. Perform field quality control testing as recommended by manufacturer. Move bridge and hoist trolley through entire travel to ensure crane is clear of obstructions and moves freely and smoothly. Inspect installed crane. Verify all bolts are tight and lock washers fully compressed.
- B. Field test crane and accessories for operating functions. Ensure crane movement is smooth and proper. Adjust as required and correct deficiencies.
- C. Clean surfaces. If necessary, touch-up paint damage, scratches, and blemishes with manufacturer provided matching paint. Protect crane from other construction operations.

3.4 DEMONSTRATING AND TRAINING

- A. Provide demonstration and training session for Owner's representative covering operation and maintenance.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 41 22 13.19

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DIVISION 43

PROCESS GAS AND LIQUID HANDLING, PURIFICATION AND STORAGE EQUIPMENT

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SECTION 43 23 00 - PROCESS PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, functional test, and provide startup services for pumping systems and appurtenances, complete and functional with electrical and control systems, as shown on the Drawings and as described herein. Pumps Include:
 - 1. P-1-1, P-1-2 Digested Sludge Pumps
 - 2. P-3-1, P-3-2 Washwater Duplex Booster Pump Skid

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. 01 10 00 – Summary
- C. 01 33 00 – Submittal Procedures
- D. 01 14 00 – Project Constraints
- E. 01 33 00 – Submittal Procedures
- F. 01 60 00 – Product Requirements
- G. 01 75 00 – Starting and Adjusting
- H. DIVISION 26 – Electrical
- I. DIVISION 40 – Process Interconnections
- J. 40 05 01 – Process Piping
- K. 40 05 50 – Process Valves and Operators
- L. 40 90 00 – Process Instrumentation and Controls

1.3 QUALITY ASSURANCE/REFERENCES

- A. Single source responsibility: All equipment, instruments, and other products specified in this Section for each piece of equipment shall be furnished by one supplier.

B. Manufacturer's Qualifications:

1. Minimum 10 years' experience in production of equipment substantially similar to the specified equipment.
2. Manufacturer's shop welds, welding procedures, and welders shall be qualified and certified in accordance with the requirements of ANSI/AWS D1.1.

C. As applicable, meet the requirements of the most recent version of the following industry standards, regulations, and requirements as may be referenced in this Section and the Contract Documents.

1. American Institute of Steel Construction (AISC)
2. American Iron and Steel Institute (AISI)
3. American Society of Testing and Materials (ASTM)
4. American Welding Society (AWS)
5. National Electrical Manufacturer's Association (NEMA)
6. National Electrical Code (NEC)
7. Underwriters Laboratory (UL and cUL)
8. Factory Mutual (FM)

1.4 SUBMITTALS

A. Prepare, deliver, and process under provisions of Section 01 33 00 SUBMITTAL PROCEDURES. Requests for proposed substitute or “or-equal” equipment/systems/products will be considered in accordance with Section 01 25 00 SUBSTITUTION PROCEDURES.

B. Complete list of all deviations from the Drawings and Specifications.

C. Shop Drawings. Provide the following:

1. Complete specifications for each part to assure compliance with these specifications
2. Seismic structural and anchorage calculations and details stamped and sealed by a Professional Engineer registered in the state of Alaska
3. Construction drawings showing complete dimensions, anchor bolts locations, and flange details
4. Materials of construction
5. Weights
6. Performance data:

- a. Delivery versus head curves
 - b. NPSH information as applicable
 - c. Recommended limits of operation
 - d. Operating efficiency
 - e. Required power
 - f. Operating rotational speed(s) at specified performance point(s)
 - g. Manufacturer's product designation including make, model
7. Electrical Motor Drive
- a. Nameplate horsepower
 - b. Full rotational speed
 - c. Class of insulation on motor windings
 - d. Identification of whether or not motor is inverter duty rated
 - e. Motor drive operating efficiency as a percentage of the applied electrical power reaching the pump drive shaft as mechanical power
 - f. Connected electrical power supply voltage, phase, and hertz
 - g. Amperage draw for different operating conditions
 - h. Motor NEMA classification
 - i. Proof of third-party listing (e.g. UL, FM, CSA NRTL).
8. Bearing type and rating
9. Seal type(s)
10. Wear ring type
11. Factory finish coating systems.
12. Special shipping, storage, and protection and handling instructions.
13. Equipment field erection requirements including weight of assembled components, and critical dimensions, fasteners and anchors.

1.5 Quality Control. Provide the following:

1. Product Information Forms per specification Section 01 60 00 PRODUCT REQUIREMENTS.
2. Functional test and results of performance confirmation checks per specification Section 01 75 00 STARTING AND ADJUSTING and required by this specification.
3. Operation and Maintenance Manuals per the requirements of Section 01 33 00, paragraph *Operation and Maintenance Manuals*, and include:
 - a. Manufacturer's installation, operation and maintenance (IOM) manual/instructions.
 - b. Maintenance schedule showing the required maintenance, frequency of maintenance, lubricants, and other items required at each regular preventative maintenance period.
 - c. Parts list and Manufacturer's recommended spare parts and special tools.
4. Per specification Section 01 43 33 MANUFACTURER'S FIELD SERVICES, provide the following to CONTRACTOR for submittal to the OWNER:
 - a. Manufacturer's Certificate of Proper Installation and Operation of the equipment and systems of this section.
 - b. Manufacturer's Certificate of Training:

1.6 MANUFACTURER'S SERVICES

- A. A manufacturer's representative for the equipment system specified herein shall be present at the job site for two (2) days duration (one (1) trip, NOT including travel time), 2 person-days of onsite service for installation assistance, inspection, verification of installation, functional and performance testing, start-up and job-site training. The schedule of the trips will be coordinated with the Owner.
- B. The Manufacturer's Representative shall be a direct employee of the Manufacturer or certified by the Manufacturer. The Manufacturer's Representative shall have over 5 years of field service experience with the equipment furnished under this contract.
- C. A Manufacturer's Certificate of Proper Installation and Operation, and Training are required for work under this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Control components shall be protected from corrosion during shipping and storage.
- B. Ship and store equipment with corrosion-inhibitor systems as recommended by the equipment manufacturer.

- C. Protect equipment during shipping from saltwater spray and freezing as recommended by the equipment manufacturer.
- D. Store equipment in clean, dry, well-ventilated area. Protect equipment from freezing and provide heated storage areas as recommended by the equipment manufacturer.

1.8 WARRANTY

- A. The pump Manufacturer shall guarantee the complete pumping assemblies for a period of 12 months after acceptance or 18 months after shipment, whichever occurs first. The warranty as specified here shall cover all defective parts, material, and workmanship.

PART 2 - PRODUCTS

2.1 GENERAL

- A. CONTRACTOR shall be responsible for:
 - 1. Coordination of equipment dimensions, weights and loadings with the listed Manufacturers and the incorporation of the selected equipment into the dimensional constraints of the site or building, within the limits of the structural and architectural concrete and steel, piping and equipment arrangement, and of other features and systems as shown on the Drawings.
 - 2. Modification of appurtenant equipment and piping to accommodate Substitute and “Or-Equal” equipment. Contractor shall notify Engineer and Owner of modifications necessary to accommodate Substitute and “Or-Equal” equipment and shall submit for review and approval the proposed modifications.
 - 3. Electrical power and automated process control work associated with the installation of wiring of the conveyor belt and appurtenances.
- B. The Contract Documents indicate specific required features of the equipment supply and systems, but do not purport to cover all details of design and construction.

2.2 ELECTRICAL

- A. Third Party Listings
 - 1. Third party certification, listing and labeling shall be provided per the regulations of the State of Alaska for equipment, systems, assemblies and panels where standards exist; and for controls and instrumentation; electrical drivers; and appurtenant electrical components. Approved third party certifiers include Underwriters Laboratories (UL), Factory Mutual (FM) and others approved by the State of Alaska. Use listed materials in the work according to the criteria for these listings.
 - 2. All equipment control panels shall be furnished with an Underwriters Laboratory label. The label shall represent approval under UL 508 Industrial Control Panels. All materials used in control panel fabrication shall be listed according to the criteria for UL 508 listing.

B. Code Conformance and Compliance

1. All work will be configured and assembled in accordance with applicable electrical codes observed in the United States and Alaska at the time the equipment is fabricated. Codes that apply include the National Electric Code, the National Electrical Contractor's Association Standards and other codes may apply as appropriate to the Work.
2. System, controls and instrumentation, and electrical drivers. Meet requirements for class, group, and division location in accordance with NFPA 70 and NFPA 820.
3. Manufacturer shall verify equipment to be shipped to job site conforms to NEC/NFPA requirements and meets the State of Alaska third party listing and labeling requirements. Equipment not meeting the requirements of this specification shall be replaced with equipment compliant with this specification, or be certified by a third party inspector at the Manufacturer's expense.

2.3 DESIGN/CONSTRUCTION REQUIREMENTS

- A. Provide systems, equipment, and components, including supports and anchorages, in accordance with the provisions of the most current version of the International Building Code (IBC) as amended by the City of Kenai. Seismic structural and anchorage calculations and details are to be stamped and sealed by a Professional Engineer registered in the state of Alaska
- B. Seismic Restraint, Load and Design: Per the requirements detailed on the Structural drawings.
- C. Area Classification: Unclassified. Unless noted otherwise on a Code Analysis Drawing.

2.4 DIGESTED SLUDGE PUMPS

- A. Tag Numbers: P-1-1, P-1-2
- B. The Digested Sludge Pumps shall be horizontal, progressing cavity Moineau principle type suitable for pumping settled digested sludge as indicated below:
 1. Settled Digested Sludge properties:
 - a. Percent Solids (w/w), %: 1 – 1.6
 - b. Dynamic viscosity, centipoise: 50
 - c. Particle size, inch: 0.1
 - d. Specific Gravity: 1.05
- C. Performances Parameters:
 1. Flow, gpm: 50
 2. Discharge Pressure, psi: 30

3. Maximum Pump, rpm: 325
4. Sliding velocity, ft/s: 4.3
5. Minimum Horsepower: 5 Hp

6. Flanges:
 - a. End Connection: 3-inch Class 125 flat face, ASTM 16.5B
 - b. Housing Connection: 4-inch Class 125 flat face, ASTM 16.5B

D. Pump Construction

1. Pump Suction and Discharge Casing
 - a. The pump casing shall be designed for the type of service specified and shall be of sufficient strength, weight, and metal thickness to ensure long life, accurate alignment, and reliable operation. The suction casing shall be constructed of close-grained cast iron and have two clean out ports. The casing shall have connection for vents, drains, and gauges.
 - b. The suction and discharge connections shall be ANSI/B16.1 flanges sized for the pump specified. The discharge flange shall have a vent/gauge connection that can be rotated in 90 increments. The discharge support feet shall be separate from the discharge flange.
 - c. The pump shall be supplied with adequate NPT connections for stuffing box drainage, pump drainage, flushing, and gauge connections.
2. Stator
 - a. The pump's stator shall be formed from Buna-N synthetic rubber, with a minimum 60 Durometer hardness. The stator shall be affixed to the suction casing by the use of four (4) thru-bolts for easy removal and replacement. Stators affixed to the suction casing by threaded connections or by snap rings will not be accepted. The suction edge of the stator shall be chamfered to allow for unrestricted flow into the pumping elements. The rubber shall be molded around the ends of the stator tube sealing the suction and discharge to prevent leakage. The use of separate O-rings and flat rings for stator sealing will not be acceptable.
3. Rotor
 - a. The rotor shall be precision machined from Alloy Steel SAE 4140 with a chromium content of 11-13.5% hardened to a Rockwell C hardness of C57-60 and then covered with heavy layers of hard chrome plating.
4. Universal Joint
 - a. The rotor shall be connected to the drive shaft by means of a connecting rod with high strength, shock resistant universal joints. The universal joints shall be a double sealed gear type, lubricated by oil. Pin joints and single sealed gear joints are not acceptable.

5. Drive Train

- a. The rotor shall be drive by means of a heavy duty sealed drive train. The rotor shall be joined to the drive shaft by means of a connecting rod with sealed gear type universal joints at each end. The sealed gear type universal joints shall be factory lubricated with oil and completely sealed from the abrasive fluid being pumps. To optimize seal and gear joint life, the connecting rod shall be of sufficient length to maintain its operating angle within 1 degree.

6. Gland Housing and Stuffing Box

- a. The pumps shall be constructed with adequately sized stuffing boxes capable of sealing the pumpage within the pump casing. The gland housing shall be field replaceable as a separate casting. The stuffing box shall be drilled and tapped for water flush or grease seal and supplied a Teflon lantern ring. Furnish a grease zerk fitting on the box.

7. Pump Drive Shaft

- a. The drive shaft shall be of the solid drive shaft design in order to avoid clogging and/or trapping of solids, which could either interrupt the movement of the connecting rod or disturb the seal of the rear gear joint. Maximum shaft deflection under normal operating conditions shall not exceed 0.002". The portion of the drive shaft which passes through the stuffing box shall be hard chrome plated. Hollow or telescoping designed drive shafts are not acceptable.
- b. The drive shaft shall be connected to a flanged gear reducer by a pin in a close coupled design to reduce the space needed for a coupling.
- c. The universal joint head shall be removable from the drive shaft to allow access to the stuffing box or mechanical seal without disturbing the drive end of the pump.

E. Pump Performance

1. The suction body of the pump shall be oversized at the entrance of the rotor and stator pumping elements to allow the free flow of high solids materials. The rotor joint head shall be set back from the stator and the leading edge of the stator shall be chamfered so not to restrict the flow into the pumping elements. If the pump does not incorporate the aforementioned features, the use of a rag deflector shall be required.

F. Dry Running Protection

1. Provide dry running stator temperature sensor/switches for each pump to continuously monitor stator temperature and report operating temperatures in excess of set point values. Controller can be set for two different switch off temperatures.

G. Motor:

1. TEFC, Premium Efficient Gearmotor with IP55 Class F insulation. Gear motor mounted inline on a Carbon Steel - 1020 baseplate.

2. 5 Hp, 230/460 V, 3 phase, 60 Hz, service factor 1.15.
3. Inverter Duty, suitable for a 10:1 constant torque turndown ratio.
4. Output speed minimum/maximum, rpm: 34/336
5. Frequency minimum/maximum, Hz: 6/60
6. Motor speed at 60 Hz, rpm: 1755
7. Gear Ratio: 5.23
8. Thermostats.
9. Manufacturer and Type: Nord, SK572.1F-112MP/4.

H. Gear Reducer:

1. The gear reducer shall be parallel in-line helical reducer with a 1.4 service factor. The gear case is to be single piece SAE 30 gray cast iron with internal reinforcements for strength rigidity. This design eliminates oil leakage, oil contamination, and gear set misalignment problems common to drives with bolt-on output cover or flanges.

I. Manufacturer and Equipment: Netzsch Pumps North America, LLC. NEMO Model NM053BY01S14K. Or approved equal.

J. Pump Control Panel LCP-1-1

1. Provide control panel meeting requirements of Section 40 67 00 INDUSTRIAL CONTROL PANELS.
2. Provide variable frequency drives for pumps in LCP-1-1 meeting requirements of Section 40 90 00 PROCESS INSTRUMENTS AND CONTROLS
3. Provide PLC control with factory loaded software in LCP-1-1 for pumps as follows:
 - a. Pump call to energize and de-energize based on control signal from Andritz Screw Press control panel
 - b. Pump operating speed control based on control signal from Andritz Screw Press control panel.
 - c. Dry run pump shut down based on both of the following
 - 1) Flow reported by FIT-1-1 below low flow set point value entered in Andritz Screw Press control panel. This condition would cause the run signal for the pumps to be terminated and the pumps de-energized
 - 2) Local Temperature Switches TS-1-1 and TS-1-2 installed directly on pumps report to LCP-1-1 temperature values higher than set point values entered for allowable pump operations. High temperature set point alarm values are entered into the Pump Control Panel LCP-1-1.

- d. High Pump Discharge Pressure pump shut down based on pressures reported by Pressure Indicator Transmitters PIT-1-1 and PIT-1-2 exceeding set point high pressure values. High set point alarm values are entered into the Pump Control Panel LCP-1-1.
 - e. Alarm Identification Test explaining what alarm condition has caused the pumps to shut down.
- 4. Provide panel front switches for the following:
 - a. E-Stop mushroom button
 - b. Panel disconnect switch
 - c. Hand Switches HOA for each pump
 - d. Hand Switches for Local Pump Speed Control
- 5. Provide panel front indicator lights for the following
 - a. Pump control panel power supply
 - b. Run status – green for run, off for de-energized
 - c. Alarm status – red for alarm condition, off for no alarms
- 6. Provide panel front Operator Interface Terminal (OIT) graphical interface touch screen for
 - a. ID of which pump is running
 - b. Entry of set point values for alarms
 - c. Display and reporting Status of pumps
 - 1) Alarm Fault Identification
 - 2) Real time display of pump stator temperature
 - 3) Real time display of pump flow rate
 - 4) Real time display of Pump operating speed

2.5 WASHWATER DUPLEX BOOSTER PUMP SKID

- A. Tag Numbers: P-3-1, P-3-2
- B. Washwater pressure booster system supplied as compact packaged assembly.
- C. Operating Conditions. The pump shall be capable of meeting all of the following performance criteria when pumping water up to a temperature of 68 degrees F:
 - 1. 48 gpm at 95-feet of TDH
 - 2. Maximum dead head pressure: 145 ft
- D. Pump: In-line, Vertical centrifugal, 3 stages
 - 1. Rated pump speed: 3298 rpm
 - 2. Shaft seal: Single, HQQE
 - 3. Impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.
 - 4. Suction/discharge base, pump head, motor stool: 316 stainless steel
 - 5. Impellers, diffuser chambers, outer sleeve: 304 Stainless Steel
 - 6. Shaft 316 Stainless Steel
 - 7. Impeller wear rings: 304 Stainless Steel
 - 8. Shaft journals and chamber bearings: Silicon Carbide
 - 9. O-rings: EPDM
 - 10. The shaft seal shall be a balanced o-ring cartridge type with the following features:
 - a. Collar, Drivers, Spring: 316 Stainless Steel
 - b. Shaft Sleeve, Gland Plate: 316 Stainless Steel
 - c. Stationary Ring: Graphite embedded Silicon Carbide
 - d. Rotating Ring: Graphite embedded Silicon Carbide
 - e. O-rings: EPDM
 - 11. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one-piece component.

E. Motors:

1. NEMA, 80B, efficiency class IE5, Insulation class F
2. 3 Hp, 460 V, 3 phase, 60 Hz, service factor 1.15
3. Controls: built-in frequency converter
4. Efficiency: The motors shall be of permanent magnet design meeting IE5 efficiency levels where the combined motor and VFD efficiency exceed NEMA Premium Efficiency standards.
5. Bearing Current Mitigation: Motors shall use WSB (Winding Set Back) and/or CHS (Coil Head Shield) designs that reduce the Bearing Voltage Ratio (BVR) far enough to eliminate damaging bearing currents. Shaft grounding rings/brushes or common mode filters shall not be required.
6. Motor Enclosure/Cooling: The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face with Class F insulation and a temperature rise class no higher than Class B. The cooling design of the motor and VFD shall be such that a Class B motor temperature rise is not exceeded at full rated load and speed at a minimum switching frequency of 9.0 kHz.
7. The power and control electronics shall be housed in a UL Type 3 enclosure and the combined motor/VFD rating shall be IP55 (protection against dust and nozzle directed water from any direction).
8. The VFD shall:
 - a. be of the PWM (Pulse Width Modulation) design using IGBT (Insulated Gate Bipolar Transistor) technology.
 - b. convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor current suitable for centrifugal pump control and to eliminate the need for motor de-rating.
 - c. automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.
 - d. include a standard integral RFI filter.
 - e. have a minimum of two skip frequency bands which can be field adjustable.
 - f. have internal solid-state overload protection designed to trip within the range of 105-110% of rated current.

9. Integrated VFD motor shall:
 - a. include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor overtemperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.
 - b. have, as a minimum, the following input/output capabilities:
 - 1) Speed Reference Signal: 0-10 VDC, 4-20mA
 - 2) Digital remote on/off
 - 3) Fault Signal Relay (NC or NO)
 - c. Fieldbus communication port (RS485)
10. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 20,000 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

F. Washwater Booster Pump Controller

1. Controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a color display with a minimum screen size of 3-1/2-inch by 4-5/8-inch for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.
2. Galvanic Isolation: The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.
3. Backup Battery: The controller shall have the ability to be connected to a backup battery to supply power to the controller during periods of loss of supply power.
4. Home Status Screen: The controller shall display the following as status readings from a single display on the controller (this display shall be the default):
 - a. Current value of the control parameter, (typically differential pressure)
 - b. Most recent existing alarm (if any)
 - c. System status with current operating mode
 - d. Status of each pump with current operating mode and rotational speed as a percentage (%)
 - e. Estimated flow-rate, (or actual flow if flow sensor is used)
 - f. One user defined measured parameter (i.e. power consumption)
5. Inputs/Outputs: The controller shall have as a minimum the following hardware inputs and outputs:

- a. Three analog inputs (4-20mA or 0-10VDC)
 - b. Three digital inputs
 - c. Two digital outputs
 - d. Ethernet connection (built-in web server)
 - e. Field Service connection to PC for advanced programming, software and/or firmware upgrades and data logging
6. Pump system programming: As a minimum, the following parameters shall be available and/or field adjustable:
 - a. Sensor Settings: Suction, Discharge, Differential Pressure [analog supply/range]
 - b. PI Controller: Proportional gain (Kp) and Integral time (Ti)
 - c. Low suction: Pressure/level shutdown via digital contact
 - d. Limit Exceeding function: For low system, low suction warnings and shut down [via analog input]
 - e. Flow meter settings (if used, analog signal)
7. Pump Curve Data: The actual pump performance curves (5th order polynomial) shall be loaded (software) into the pump system controller. Pump curve data shall be used for the following:
 - a. Display and data logging of calculated flow rate
 - b. Variable pressure control (quadratic or proportional)
 - c. Pump outside of duty range protection
 - d. Sequence pumps based on efficiency
8. Variable Pressure Control: The controller shall have variable pressure control to compensate for pipe friction loss by decreasing the pressure set-point at lower flow-rates and increasing the pressure set-point at higher flow-rates by using the actual flow rate or calculated flow rate.
9. Multi-Sensor: The controller shall be able to control using up to six differential pressure (DP) sensors (zones). Each zone shall have a programmable maximum and minimum DP range. The controller shall be capable of an energy optimal mode where pump speed/energy shall be reduced until any of the zones reach the minimum DP setting.
10. Check Valve Failure Detection (Systems with integrated VFD motors): The system controller shall be able to detect motors turning in the opposite direction and give check valve failure notification.
 - a. For minor leaks the pump shall start with a warning indicated

- b. For major leaks the pump shall remain off to prevent damage with an alarm indication
11. Pulse flow meter: The system controller shall be able to receive pulse readings from a digital pulse meter and log/display accumulated flow.
 12. DP Subtraction: The system controller shall be able to control off subtraction of two pressure or temperature sensors for differential pressure or differential temperature control.
 13. Programmable Setpoints: The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).
 14. Setpoint Influence: The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence.
 15. Remote Control: The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.
 16. Setpoint Ramp: The controller shall be able to adjust the ramp time of a change in set point (increase and decrease).
 17. Warnings and Alarms: The pump system controller shall store up to 24 warnings and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:
 - a. Individual pump failure
 - b. Check valve failure
 - c. VFD trip/failure
 - d. Loss of sensor signal (4-20 mA)
 - e. Loss of remote set-point signal (4-20mA)
 - f. External Fault
 - g. Pump outside of duty range
 - h. Limit 1 and 2 exceeded*
 - 1) *The controller shall be capable of monitoring two analog signals (i.e. suction pressure and discharge pressure) for additional pump or system protection.
 18. Built-in data log: The controller shall have built-in data logging capability. Logged values shall be graphically displayed on the controller and shall be downloadable to a notebook/pc as a delimited text file. A minimum of 7200 samples per logged value shall be available for the following parameters:
 - a. Estimated flow-rate (or actual flow if flow sensor is connected)

- b. Speed of pumps
 - c. Process Value/sensor feedback (usually differential pressure)
 - d. Power consumption
 - e. Controlling parameter (setpoint)
 - f. Inlet pressure (when remote differential pressure is the primary sensor)
- 19. Redundant Primary Sensor: The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor.
 - 20. Secondary Sensor: Upon loss of signal from the remote sensor, the controller shall be capable of reverting control to the pump system mounted sensors with a programmable setpoint. The pumps shall maintain a constant, proportional or quadratic pressure across the system until the remote setpoint signal is restored.
 - 21. Pump Test: The controller shall have a pump “Test Run” feature such that pumps are switched on during periods of inactivity (system is switched to the “off” position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of three to four seconds every 24 hours, 48 hours or once per week and at a programmable time of day.
 - 22. Reduced Operation: During backup generator operation, the controller shall be capable of reducing the power consumed by the pump system by either limiting the number of pumps in operation or by limiting the amount of power consumption (kW). The controller shall receive a digital input indicating backup generator operation.
 - 23. Power and Energy Consumption: The controller shall be capable of displaying instantaneous power consumption (Watts or kilowatts) and cumulative energy consumption (kilowatt-hours).
 - 24. Specific Energy: When a flow sensor is connected, the controller shall be capable of displaying instantaneous specific energy in Watt-hours per gallon (Wh/gal) or Watt-hours per 1,000 gallons (Wh/kgal).
 - 25. Built-in Ethernet: The controller shall have an Ethernet connection with a built-in web server allowing for connection to a building computer network with read/write access to the controller via a web browser.
 - 26. Service Contact Information: The controller shall have a programmable Service Contact Field that can be populated with service contact information including: contact name, address, phone number(s) and website.
 - 27. Controller to be Grundfos CU352. Controller to be configured to operate one or both pumps as needed to maintain operator selectable set point value for pump discharge pressure.

G. WASHWATER BOOSTER PUMPS CONTROL PANEL

1. SCCR: The complete control panel assembly shall have a Short Circuit Current Rating of 100 kA
2. BMS Integration: Standard shall be BACnet MS/TP
 - a. *Other protocols available: BACnet IP, Ethernet IP, Modbus RTU, Modbus TCP, LON
3. The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire UL Type 3R control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions. The control panel shall include the following:
 - a. 80 dB System Fault Audible Alarm with push button to silence
 - b. Emergency/Normal Operation Switches (Control bypass)
 - c. Individual Service Disconnect Switches (accessible outside of panel)
 - d. Pump Run Lights
 - e. System Fault Light
 - f. Surge Arrestor

H. PUMP SKID CONSTRUCTION

1. Suction and discharge manifolds: 2½-inch 316 stainless steel Schedule 10S.
2. Pump connection to manifolds: 1½-inch 316 stainless steel Schedule 10S.
3. Pump Isolation: 1½-inch nickel plated brass full port ball valves shall be provided on the suction and discharge of each pump.
4. A 2-inch spring-loaded non-slam type check valve with body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat with stainless steel spring and disk shall be installed on the discharge of each pump.
5. A non-code, 150 psi maximum, 10.3 gallons Diaphragm tank with a connection no smaller than ¾inch shall be provided on the discharge manifold.
6. A pressure transducer shall be factory installed on the discharge manifold. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.
7. A bourdon tube pressure gauge, 2.5 inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts

in a stainless steel case. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.

8. The base frame shall be constructed of corrosion resistant 304 stainless steel,
 9. Rubber vibration dampeners shall be fitted between each pumps and base frame to minimize vibration.
 10. Control panel shall be mounted a 304 stainless steel base (floor mounted with plinth).
- I. Manufacturer and Equipment: Grundfos, Hydro MPC E system 100kA SCCR, 2CRE 10-3 HQQE 3x460V 60Hz.

2.6 ACCESSORIES

A. Equipment Identification Plates:

1. The manufacturer or supplier of the equipment shall identify each unit of equipment with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, electrical specifications, equipment capacity, supplier's name and location.
2. A 16-gauge stainless steel identification plate shall be securely mounted on the equipment in a readily visible location. The plate shall bear the ¼-inch die-stamped equipment name and identification tag numbers indicated in this Specification and shown on the Drawings.

B. Anchor Bolts:

1. Equipment Manufacturer/CONTRACTOR shall furnish required anchor bolts of size and strength required to securely anchor each item of Manufacturer's equipment, consistent with the Seismic design requirements stipulated by the Contractor furnished seismic anchorage calculations and details stamped and sealed by a Professional Engineer registered in the state of Alaska
2. Anchor bolts, hex nuts, and washers shall be stainless steel Type 316 stainless steel, wedge or epoxy type.
3. Anchor bolts shall be set by the CONTRACTOR. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

2.7 LUBRICANTS

- A. The CONTRACTOR shall furnish all lubricants required for startup, initial operation, and testing of the equipment as recommended by the manufacturer.

2.8 SPARE PARTS AND SPECIAL TOOLS

- A. Manufacturer shall clearly identify and furnish any special tools and any spare parts required for a two-year period of operation and maintenance of the equipment.

- B. All Spare Parts shall be provided in protective packaging for long-term storage.
- C. Special Tools shall be provided in packaging designed for storage and repeated use.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify equipment provided to the job site conforms to NEC/NFPA requirements and meets the State of Alaska third party listing and labeling requirements.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in undamaged condition, in Manufacturer's original container or packaging, with identifying labels intact and legible.
- B. Unload products in accordance with Manufacturer's instructions. Record the receipt of products at the site.
- C. Inspect for completeness and evidence of damage during shipment. Remove damaged products from the site and expedite delivery of identical new undamaged products and remedy incomplete or lost products to provide specified products so as not to delay the progress of the Work.
- D. Handle and store products in accordance with the Manufacturer's instructions.
- E. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60-degrees F. Protect electrical, instrumentation, and control products, and insulation against moisture, water, and dust damage.
- F. Store fabricated products aboveground, on blocking or skids, and prevent soiling or staining. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- G. Store finished products that are ready for installation in dry and well ventilated areas.

3.3 INSTALLATION

- A. Install in accordance with Manufacturer's written instructions.
- B. Connect suction and discharge piping to the pumps without imposing strain to pump flanges.
- C. Install equipment anchors, supports, and seismic bracing per the requirements of the Manufacturer, as indicated on Drawings, and consistent with the Seismic requirements of the project.

- D. Prior to assembly all stainless steel bolts and nut threads shall be coated with a non-seizing compound by the Contractor.
- E. Anchor Bolts: Accurately place using equipment templates.
- F. Install electrical power circuits, instrumentation and control wiring and associated raceways as shown on the Drawings and required by Division 26 ELECTRICAL.
- G. Install all control and electrical equipment as per the manufacturer's recommendations and to provide operation as described in Section 40 90 00 PROCESS INSTRUMENTATION AND CONTROLS, and as shown on the Drawings.
- H. Prior to start-up of the facility, inspect, test, and document that the electrical and control systems are operational.
- I. Upon completion of installation and prior to equipment functional and performance testing, CONTRACTOR shall thoroughly clean structures, equipment, pipe, and related appearances free of all construction debris, trash and other materials that may be detrimental to the operation equipment in this specification.

3.4 FIELD QUALITY CONTROL

- A. Functional and Performance Testing:
 - 1. Conduct on each pump system under actual or approved simulated operating conditions.
 - a. Test for a continuous 3-hour period without malfunction.
 - b. Verify correct operation of all control and alarm functions.
 - c. Alignment: Test complete assemblies for correct rotation, and quiet operation.
 - d. Operating Temperatures: Monitor bearing areas on equipment and motor for abnormally high temperatures.
 - e. As applicable, No-Flow Detection Shutoff, two-point setpoint performance
 - 2. Test Log: Record the following:
 - a. Total head, Capacity, Horsepower requirements
 - b. Insulation resistance measured on the stator and power cables.
 - c. Drive motor operating voltage and amperage measured for each phase under peak load/pump output operating conditions and no load.

3.5 RECORD DRAWINGS

- A. CONTRACTOR shall maintain a current set of construction drawings and specifications that reflect any changes, modifications, clarifications, additions, or deletions from the Contract

Documents per specification Section 01 78 39 PROJECT RECORD DOCUMENTS. Annotations shall include any CONTRACTOR issued equipment or wiring identification tags and/or numbers. Record drawing information shall be provided to the OWNER at the completion of system start up and substantial completion.

3.6 MANUFACTURERS' SERVICES

- A. Manufacturers' Services are required for the Digested Sludge Pumps
- B. Independent of the Digested Sludge Pump services, Manufacturers' Services are also required for the Wash Water Booster Pumps.
- C. Installation Inspection: Prior to system start up, for each set of pumps, the respective Equipment Supplier shall inspect the installation of the equipment including instrumentation, and control and power wiring to verify system installation is satisfactory for operation.
- D. Startup Services: For each set of pumps, the respective Equipment Supplier shall provide a technical representative to the project site to observe the startup of the equipment, make adjustments to the equipment, and troubleshoot problems with the equipment as needed.
 - 1. Operator Training: The Equipment Supplier shall provide a minimum of 4 hours of training at the project site to review the Operations and Maintenance (O&M) Manuals for the project with the operations personnel.
 - a. O&M Manuals used for the training must have prior approval by OWNER through the submittal process prior to use in the training.
 - b. Equipment Supplier to provide OWNER signatures of operators attending the training certifying they have completed the training provided for the project.
- E. Notify OWNER and Manufacturer in writing, 10-days prior to the date when the installation will be ready for inspection.

3.7 TROUBLESHOOTING SERVICES

- A. If pumps do not meet manufacturer's published performance ratings or the requirements of this specification, CONTRACTOR and Manufacturer's Representative shall provide troubleshooting services to identify the cause of the problem.
- B. If performance problems are due to defects in the work installed by the CONTRACTOR, CONTRACTOR shall correct the defective work at no cost to the OWNER.
- C. If pumps do not meet the manufacturer's performance criteria due to material or workmanship defects in the equipment, CONTRACTOR shall, with the assistance of the Manufacturer's Representative for that equipment, identify the fault and recommend repair and/or replacement of the faulty component or components to the OWNER.

3.8 FIELD FINISHING AND TOUCHUP

- A. Provide field finishing and touchup as recommended by the Manufacturer.

3.9 FINAL CLEAN

- A. Clean surfaces in accordance with Manufacturer's written instructions.

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DIVISION 46

INDUSTRY SPECIFIC MANUFACTURING EQUIPMENT

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SECTION 46 33 33 – POLYMER BLENDING AND FEED EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, functional test, and provide startup services for Polymer (emulsion) Blending and Feed Equipment and appurtenances, complete and functional with interconnecting piping and valves, and electrical and control systems, as shown on the Drawings and as described herein.
- B. Furnish Polymer (emulsion) supply for start-up and functional check out purposes.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. 01 10 00 – Summary
- C. 01 33 00 – Submittal Procedures
- D. 01 43 33 – Manufacturer’s Field Services
- E. 01 60 00 – Product Requirements
- F. 01 75 00 – Starting and Adjusting
- G. 03 30 00 – Cast in Place Concrete
- H. DIVISION 26 – Electrical
- I. DIVISION 40 – Process Interconnections
- J. 40 05 01 – Process Piping
- K. 40 05 50 – Process Valves and Operators
- L. 40 72 73 – Sight Level Gages
- M. 40 90 00 – Process Instrumentation and Controls
- N. 43 23 00 – Process Pumps
- O. 46 41 41 Tank Mixer Equipment

1.3 QUALITY ASSURANCE/REFERENCES

- A. Single source responsibility: All equipment, instruments, and other products specified in this Section for each piece of equipment shall be furnished by one supplier.
- B. Manufacturer's Qualifications:
 - 1. Minimum 15 years' experience in production of equipment substantially similar to the specified equipment.
 - 2. Manufacturer's shop welds, welding procedures, and welders shall be qualified and certified in accordance with the requirements of ANSI/AWS D1.1.
- C. As applicable, meet the requirements of the most recent version of the following industry standards, regulations, and requirements as may be referenced in this Section and the Contract Documents.
 - 1. American Institute of Steel Construction (AISC)
 - 2. American Iron and Steel Institute (AISI)
 - 3. American Society of Testing and Materials (ASTM)
 - a. A322: Carbon and Alloy Steel Bar Specifications.
 - b. A507-10: Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled
 - 4. American Welding Society (AWS)
 - a. A2.4 Standard Symbols for Welding, Brazing, and Nondestructive Examination
 - b. B2.1 Specification for Welding Procedure and Performance Qualification
 - c. D1.1 Structural Welding Code, Steel
 - d. D1.6 Structural Welding Code Stainless Steel
 - e. D1.8 Structural Welding Code – Seismic Supplement
 - f. QC1 Standard for AWS Certification of Welding Inspectors
 - 5. Hydraulic Institute
 - 6. National Electrical Manufacturer's Association (NEMA) Standards
 - 7. National Electrical Code (NEC)
 - 8. Underwriters Laboratory (UL and cUL)
 - 9. Factory Mutual (FM)

10. International Building Code (IBC) Seismic loading and bracing as amended by the City of Kenai.
- D. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1 Structural Welding Code, Steel
 2. AWS D1.6 Structural Welding Code Stainless Steel
 3. AWS D10.4 Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing
- 1.4 SUBMITTALS
- A. Prepare, deliver, and process under provisions of Section 01 33 00 SUBMITTAL PROCEDURES. Requests for proposed substitute or “or-equal” equipment/systems/products will be considered in accordance with the provisions of paragraph “Substitute and “Or-Equal” Products”.
- B. Complete list of all deviations from the Drawings and Specifications.
- C. Shop Drawings. Provide the following:
1. Certification that field measurements have been verified prior to drawing release.
 2. Previous installation list. Installations shall be only those in the United States. Information submitted shall include but not be limited to:
 - a. Name and location of installation. Name, address and phone number of person in direct responsible charge.
 - b. Month and year the equipment was placed in operation.
 - c. Brief description of equipment.
 3. Polymer (emulsion) blending and mixing unit with progressive cavity pump, motors, controls, and appurtenances, skidded
 - a. Polymer Activation and Blending Chamber
 - b. Dilution Water Assembly
 - c. Progressive Cavity Neat Polymer Metering Pump
 - d. Solution Discharge Assembly
 - e. Controls, Operator Interface
 - f. Pipe, valves, and appurtenances
 4. Neat polymer storage tank T-5-1

- a. Scaled drawings illustrating tank configuration and dimensions
 - 1) Elevation view showing
 - a) Manway
 - b) Top entry of all piping
 - c) Radial locations of all pipe entry
 - 2) Plan view showing all pipe entry elevations
 - b. Materials of construction
 - 1) Tank
 - 2) Manway cover
 - 3) Bulkhead pipe fittings and elastomers
- D. Shop drawings shall include:
- 1. Scaled images dimensioned to provide accurate representations of the physical size and configurations of equipment. Include:
 - a. views of the equipment. plan view and elevations from all directions.
 - b. recommended clearances and floor mounting/anchoring details
 - 2. Process piping, control panel details, instrumentation details, and structural components intended to support the components furnished.
 - 3. Identify the number of pieces to be shipped as separate components for assembly at the project site.
 - 4. Contractor furnished Seismic structural and anchorage calculations and details stamped and sealed by a Professional Engineer registered in the state of Alaska
- E. Provide Equipment Product Data Submittals for review and approval prior to procurement of materials or initiation of fabrication for this Work. Provide equipment product data submittals and information for the following:
- 1. Control System Polymer (emulsion) Blending and Feed Equipment and appurtenances
 - a. Electrical Power and Control System Submittal: Provide the following process equipment power and control submittals:
 - 1) Panel layout drawings for all control panels furnished including main control panel and Polymer solution pump control panel(s).
 - 2) Control schematic drawings for all control panels furnished. Schematic drawings shall indicate
 - 3) All terminal blocks in the system,
 - 4) Devices and wire numbers connected to panel terminal blocks
 - 5) Logic used to control the process
 - 6) Process and Instrument Diagrams (P&ID's)

- 7) Text of the control logic used in controlling the process equipment
- 8) Control Panel Assembly Electrical Ratings: Voltage, Current, Feeder Size and Fault Current Rating (SCCR).
- 9) Bill of Materials for all Electrical Power and Control Components used in the panel.
- 10) Electrical Power and Control Components
- 11) Recommended spare parts lists for control panel assemblies.

b. Operator Interface

F. Quality Control. Provide the following:

1. Product Information Forms per specification Section 01 60 00 PRODUCT REQUIREMENTS.
2. Functional test and results of performance confirmation checks per specification Section 01 75 00 STARTING AND ADJUSTING and required by this specification.
3. Operation and Maintenance Manuals per the requirements of Section 01 33 00, paragraph *Operation and Maintenance Manuals*, and include:
 - a. Contact information for support of equipment operation and/or maintenance procedures.
 - b. Parts and components of the equipment supplied, Manufacturer's recommended spare parts and special tools, and source of supply.
 - c. Recommended operating procedures, and expected equipment performance and limitations.
 - d. Recommended maintenance and repair procedures.
 - e. Safety precautions and procedures.
 - f. Maintenance schedule showing the required maintenance, frequency of maintenance, lubricants, and other items required at each regular preventative maintenance period.
4. Per specification Section 01 43 33 MANUFACTURER'S FIELD SERVICES, provide the following to CONTRACTOR for submittal to the Owner and Engineer:
 - a. Manufacturer's Certificate of Proper Installation and Operation of the equipment and systems of this section.
 - b. Manufacturer's Certificate of Training:

1.5 MANUFACTURER’S SERVICES

- A. A manufacturer’s representative for the equipment system specified herein shall be present at the job site for four (4) days total duration NOT including travel time (this will consist of two separate trips for a total of four days spent on site), the first trip is intended for initial onsite installation assistance, inspection, and verification of installation. The second trip is intended to perform final functional and performance testing, start-up and job-site training. The schedule of the trips will be coordinated with OWNER.
- B. The Manufacturer’s Representative shall be a direct employee of the Manufacturer or certified by the Manufacturer. The Manufacturer’s Representative shall have over 5 years of field service experience with the equipment furnished under this contract.
- C. A Manufacturer’s Certificate of Proper Installation and Operation, and Training are required for work under this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Control components shall be protected from corrosion during shipping and storage.
- B. Ship and store equipment with corrosion-inhibitor systems as recommended by the equipment manufacturer.
- C. Protect equipment during shipping from saltwater spray and freezing as recommended by the equipment manufacturer.
- D. Store equipment in clean, dry, well-ventilated area. Protect equipment from freezing and provide heated storage areas as recommended by the equipment manufacturer.
- E. Cover panels and other control elements to protect from dust during construction.

1.7 WARRANTY

- A. The pump Manufacturer shall guarantee the complete pumping assemblies for a period of 12 months after acceptance or 18 months after shipment, whichever occurs first. The warranty as specified here shall cover all defective parts, material, and workmanship.
- B. The responsible Manufacturer shall replace all items deemed by the manufacturer to be defective without cost to the OWNER.

PART 2 - PRODUCTS

2.1 GENERAL

- A. CONTRACTOR shall be responsible for:
 - 1. Coordination of equipment dimensions, weights and loadings with the listed Manufacturers and the incorporation of the selected equipment into the dimensional

constraints of the site or building, within the limits of the structural and architectural concrete and steel, piping and equipment arrangement, and of other features and systems as shown on the Drawings.

2. Modification of appurtenant equipment and piping to accommodate Substitute and “Or-Equal” equipment. Contractor shall notify Engineer and Owner of modifications necessary to accommodate Substitute and “Or-Equal” equipment and shall submit for review and approval the proposed modifications.
 3. Electrical power and automated process control work associated with the installation of wiring of the screens and appurtenances.
- B. The Contract Documents indicate specific required features of the equipment supply and systems, but do not purport to cover all details of design and construction.

2.2 ELECTRICAL

A. Third Party Listings

1. Third party certification, listing and labeling shall be provided per the regulations of the State of Alaska for equipment, systems, assemblies and panels where standards exist; and for controls and instrumentation; electrical drivers; and appurtenant electrical components. Approved third party certifiers include Underwriters Laboratories (UL), Factory Mutual (FM) and others approved by the State of Alaska. Use listed materials in the work according to the criteria for these listings.
2. All equipment control panels shall be furnished with an Underwriters Laboratory label. The label shall represent approval under UL 508 Industrial Control Panels. All materials used in control panel fabrication shall be listed according to the criteria for UL 508 listing.

B. Code Conformance and Compliance

1. All work will be configured and assembled in accordance with applicable electrical codes observed in the United States and Alaska at the time the equipment is fabricated. Codes that apply include the National Electric Code, the National Electrical Contractor’s Association Standards and other codes may apply as appropriate to the Work.
2. System, controls and instrumentation, and electrical drivers. Meet requirements for class, group, and division location in accordance with NFPA 70 and NFPA 820.
3. Manufacturer shall verify equipment to be shipped to job site conforms to NEC/NFPA requirements and meets the State of Alaska third party listing and labeling requirements. Equipment not meeting the requirements of this specification shall be replaced with equipment compliant with this specification, or be certified by a third party inspector at the Manufacturer’s expense.

2.3 DESIGN/CONSTRUCTION REQUIREMENTS

- A. Provide systems, equipment, and components, including supports and anchorages, in accordance with the provisions of the most current version of the International Building Code (IBC) as amended by the City of Kenai. Seismic structural and anchorage calculations and details are to be stamped and sealed by a Professional Engineer registered in the state of Alaska
- B. Seismic Restraint, Load and Design: Per the requirements detailed on the Structural drawings.
- C. All welds shall be ground and polished smooth and passivated. See passivation requirements of paragraph FACTORY/SHOP SURFACE PREPARATION AND COATING.
- D. Skid:
 - 1. Frame and Hardware: 304 stainless steel with integral stainless steel drip pan located under the neat polymer metering pump.
 - 2. All piping shall be rigidly supported.
 - 3. Progressive Cavity Pump suction elevation shall not exceed 5-inches from the bottom of the skid.
 - 4. The overall system footprint shall not exceed 34-inch width and 30-inch depth.
- E. Area Classification: Unclassified. Unless noted otherwise on a Code Analysis Drawing.

2.4 PERFORMANCE CRITERIA

- A. Polymer (emulsion) Blending and Feed Equipment and appurtenances shall meet the following minimum performance criteria:
 - 1. Fully blend emulsion polymer and water, and effectively activate polymer solution ranging from 0.1% to 1% concentration of emulsion polymers with active contents up to 75%.
 - 2. Active Content Neat Polymer: 35%
 - 3. Solution Concentration Design Point: 0.5% based on Neat Polymer

2.5 POLYMER (EMULSION) BLENDING AND FEED EQUIPMENT

- A. Manufacturer and Model:
 - 1. Velocity Dynamics Inc. Veloblend VM-P Inline, Control Level D. Or approved equal.
- B. Polymer Activation and Blending Chamber:
 - 1. Multi-stage Hydro-Mechanical polymer blending technology with both a non-mechanical and mechanical mixing stage as follows:

- a. Non-Mechanical mixing Stage device shall be capable of activating and blending polymer based on plant water pressure alone at 30 psid or greater. Polymer shall be injected directly into a water jet by means of an injection quill positioned such that the non-mechanical mixing energy is in no way diminished prior to polymer and water contact. The non-mechanical zone shall be designed such that the velocity of the mixing energy producing water jet is maintained or increases as flow decreases.
 - b. Hydro-Mechanical mixing Stage device shall be capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable stainless steel hydro-mechanical mixer. The mixing impeller shall be fully controllable and capable of inducing ultra high, non-damaging mixing energy at all flow rates. The polymer mixing impeller shall be designed to produce both axial and radial flow to optimize mixing effectiveness and to effectively induce high, non-damaging mixing energy over the full flow range of the system.
2. Mixing chamber shall maintain high velocity in the entire chamber to prevent polymer build-up.
3. Mixing impeller shall be controlled by an SCR motor controller and driven by a wash-down duty motor. The motor shall be mounted horizontally or above the mixing chamber.
4. Mixer drive shaft shall be sealed by a mechanical seal integrally mounted and factory plumbed seal flush. A drain hole behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. All bearings shall be external from the mixing chamber.
5. Both mechanical and non-mechanical mixing zones shall be clear polycarbonate to view the mixing action and blending effectiveness. The clear polycarbonate shall include a stainless steel reinforced gusseted flange with a stainless steel discharge connection required of the maximum operating pressure.
6. Mixing chamber shall have a maximum rated pressure of 100 psi. Pressure relief valve on the mixing chamber shall be factory set at 75 psi.
7. Neat polymer check valve shall be specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. To minimize check valve plugging due to normally occurring polymer agglomerations, the minimum open area up to and including the valve seat shall be 3/16-inch. The valve body shall be constructed of Teflon with Viton seals. The valve poppet and spring shall be stainless steel. The spring shall be outside of the polymer flow path to prevent build-up and plugging. The locking pin used to hold the valve in place shall be attached to the mixing chamber with a lanyard. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement.
8. Dilution Water Assembly
 - a. Dilution water flow shall be monitored by a Rotameter flow meter with a range between 6 and 60 gallons per hour. Unions or flanges shall be provided on the flow meter to allow easy removal for cleaning.

- b. Solenoid valve control, slow-closing, 1½-inch for ON/OFF control of dilution water flow.
 - c. Pressure Gauge, PI-5-1. 2½-inch stainless steel liquid filled, with a range of 0 to 160 psi.
 - d. Pressure Differential Switch, PDS-5-1. NEMA 4X rated, adjustable between 9 and 60 psid. Static working pressure, 500 psi. Pressure Differential Switch provides Low Water Pressure Alarm signal to Control Panel.
 - 9. Progressive Cavity Neat Polymer Metering Pump
 - a. Neat Polymer Metering Pump with a flow range of 0.15 to 3 gallons per hour integrally mounted on the skid. Positive displacement, progressive cavity type constructed of stainless steel and Viton. The shaft seal shall be an adjustable packing type.
 - 1) Motor: 90 VDC wash-down duty.
 - 2) Gear Reducer: Gear assembly to control maximum pump shaft speed The drive motor speed shall be controlled by motor controller located in Control Panel.
 - b. Calibration Column including two full port PVC ball valves having Viton o-rings. The column shall be calibrated for a one minute draw-down at maximum pump rate and read in GPH and milliliters. The calibration column shall be rigidly mounted to the systems frame with a minimum of two heavy duty brackets. Provide a breather plug in the top of the calibration column designed to allow adequate displacement of air during calibration while preventing water or other foreign material from entering the calibration column.
 - c. Flow Switch Low FSL-5-1. Polymer flow sensor, thermal non-intrusive type, including stainless-steel plumbing assembly with a stainless-steel full port ball valve for draining during cleaning. Thermal Flow Switch provides Low Polymer Flow Alarm signal to Control Panel.
 - 10. Solution Discharge Assembly:
 - a. Pressure Gauge, PI-5-2. 2½-inch stainless steel liquid filled, with a range of 0 to 160 psi.
- C. Polymer Blending and Feed Equipment Control Panel, LCP-5-1
 - 1. LCP shall include all controllers, digital displays, potentiometers, switches, lights, relays, motor starters and other control devices required for a complete operable system.
 - 2. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 gauge wire. Wires shall be neatly run through wire race-way and numbered with shrink tubing type labels.

3. The control panel shall be positioned such that there are no obstructions in front of the control panel per related NFPA requirements.
4. Future Automation Control Capabilities
 - a. Configure the control panel to accommodate control of future addition of the following equipment:
 - 1) Dilute polymer solution mix and age tank with mechanical mixer.
 - 2) Duty/redundant dilute polymer dosing pumps.
 - 3) I/O signals for
 - a) polymer dosing pump run confirmation
 - b) mix/age tank mixer run confirmation
 - c) Failure of polymer dosing pump
 - d) Failure of mix/age tank mixer
5. Panel Enclosure: NEMA 4X (FRP)
6. Power:
 - a. 480 VAC, three phase, 60 Hz
 - b. Disconnect Switch: rotary style main power disconnect switch
 - c. Circuit Breakers: Main control Circuit and each motor
 - d. Emergency disconnect mushroom button to de-energize panel operations
7. Operator Interface – Discrete Selector Switches:
 - a. System ON / OFF (reset) / Remote
 - b. One-Turn Potentiometer – Polymer Blend Mixer Speed
 - c. Ten-Turn Potentiometer – Neat Polymer Progressive Cavity Metering Pump Control
8. Neat Polymer Storage Tank Mixer Motor Controller
 - a. VFD motor controller for MXR-5-1 mounted in LCP-5-1
 - b. Operator interface to enable selection of mixer operating speed from LCP-5-1
 - c. See Section 40 90 00 – PROCESS INSTRUMENTS AND CONTROLS for VFD requirements.
9. Status / Alarm Indicators:
 - a. Main Power ON
 - b. Low Water Differential Pressure Alarm

- c. Low Polymer Flow Alarm
- 10. Inputs (signals by others):
 - a. Remote Start / Stop (discrete dry contact)
 - b. Pacing Signal Based on Process Flow (4-20mA)
- 11. Outputs:
 - a. System Running (discrete dry contact)
 - b. Remote Mode (discrete dry contact)
 - c. Common Alarm (discrete dry contact)
- 12. Control panel to be mounted on skid and pre-wired to skid mounted components.
- 13. Control panel shall be fabricated using UL listed components and have a UL approval label.

2.6 FACTORY/SHOP SURFACE PREPARATION AND COATING

- A. Electric motors, speed reducers, and other self-contained or enclosed components shall have manufacturer's standard enamel finish.
- B. Stainless steel and other corrosion-resistant surfaces shall not be coated.

2.7 ACCESSORIES

A. NEAT POLYMER HOLDING TANK

- 1. Tag Number: T-5-1
- 2. Design Criteria
 - a. Capacity: minimum 500-gallons
 - b. Configuration: Vertical with vented access way on top, and including fittings required for accommodating interconnecting piping and appurtenances.
 - c. Design Pressure: atmospheric
 - d. Tank Material and Color: cross-linked high density polyethylene (XLPE)), Natural White
 - e. Storage Contents: Neat Polymer. See POLYMER (EMULSION) this Specification.
 - f. Temperature range: 45 to 85 °F.

- g. Seismic anchorage and bracing systems shall be designed in accordance with the provisions of the most current version of the International Building Code (IBC) as amended by the City of Kenai. The design is to be stamped and sealed by a qualified professional engineer licensed in the state of Alaska and submitted for review (deferred submittal) and approval.
 - 3. Manufacturer and Model: Snyder part number 1800400N, or approved equal.
- B. TANK PIPE CONNECTION BULKHEAD FITTINGS
 - 1. Banjo Polyethylene Bulkhead Fittings
 - 2. EPDM elastomer seals
 - 3. National pipe thread connections
- C. TANK MIXER MXR-5-1
 - 1. See specification Section 46 41 41 - TANK MIXER EQUIPMENT
- D. SIGHT LEVEL GAGE LI-5-1
 - 1. See specification Section 40 72 23 - SIGHT LEVEL GAGES
- E. 55 GALLON DRUM ACCESSORIES
 - 1. Drum pump used to unload 55 gallon poly barrels of delivered polymer will be Contractor furnished. Contractor to furnish two (2) barrel pumps; one barrel pump plus one spare. Barrel pumps shall be electric pumps consisting of:
 - a. Motor B55T-5 with 16 ft cord, pump tube PVDF 39" seal-less, high head impeller, Hastelloy C shaft, PP Barrel Adaptor, 1" PVDF Nozzle with swivel, 8' Chemical Hose, Hose Clamps, Wall Hanger
 - b. Lutz Pumps Inc. 0205-201-1 or equal
 - 2. Chemical hose used to convey polymer from drum pump to T-5-1 to be provided by Contractor. See specification Section 40 05 01 – PROCESS PIPING
- F. DRY DISCONNECT VALVE ASSEMBLIES FV-5-1 and FV-5-2
 - 1. Dry disconnect valve assemblies on each end of drum pump chemical hose to be provided by Contractor. See specification 40 05 50 – PROCESS VALVES AND OPERATORS
- G. EQUIPMENT IDENTIFICATION PLATES:
 - 1. The manufacturer or supplier of the equipment shall identify each unit of equipment with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, electrical specifications, equipment capacity, supplier's name and location.

2. A 16-gauge stainless steel identification plate shall be securely mounted on the equipment in a readily visible location. The plate shall bear the ¼-inch die-stamped equipment name and identification tag numbers indicated in this Specification and shown on the Drawings.

H. ANCHOR BOLTS:

1. CONTRACTOR shall furnish required anchor bolts of size and strength required to securely anchor each item of Manufacturer's equipment, consistent with the Seismic requirements of the project.
2. Anchor bolts, hex nuts, and washers shall be stainless steel Type 316 stainless steel, wedge or epoxy type.
3. Anchor bolts shall be set by the CONTRACTOR. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

2.8 LUBRICANTS

- A. CONTRACTOR shall furnish all lubricants required for startup, initial operation, and testing of the equipment as recommended by the Manufacturer.

2.9 SPARE PARTS AND SPECIAL TOOLS

- A. Manufacturer shall clearly identify and furnish special tools and spare parts as follows:
 1. One (1) progressive cavity pump stator
 2. One (1) progressive cavity pump shaft seal
 3. One (1) banding clamp tool for replacement of the progressive cavity metering pump pin joint banding clamps.
 4. One (1) neat polymer check valve, complete
- B. All Spare Parts shall be provided in protective packaging for long-term storage.
- C. Special Tools shall be provided in packaging designed for storage and repeated use.

2.10 POLYMER (EMULSION)

- A. Manufacturer and Product Name: SNF Holding Company (Polydyne), Polydyne C-6276 [generically: Cationic Polyacrylamide].
- B. CONTRACTOR shall supply four (4) 55-gallon drums for their start-up and functional check out purposes and for operations up to 30-days.
- C. CONTRACTOR shall also supply an additional eight (8) 55-gallon drums to provide the Owner with a preliminary supply of polymer for their operations

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify equipment provided to the job site conforms to NEC/NFPA requirements and meets the State of Alaska third party listing and labeling requirements.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in undamaged condition, in Manufacturer's original container or packaging, with identifying labels intact and legible.
- B. Unload products in accordance with Manufacturer's instructions. Record the receipt of products at the site.
- C. Inspect for completeness and evidence of damage during shipment. Remove damaged products from the site and expedite delivery of identical new undamaged products and remedy incomplete or lost products to provide specified products so as not to delay the progress of the Work.
- D. Handle and store products in accordance with the Manufacturer's instructions. Store delivered products at the Wastewater Treatment Plant where directed by OWNER.
- E. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60-degrees F. Protect electrical, instrumentation, and control products, and insulation against moisture, water, and dust damage.
- F. Store fabricated products aboveground, on blocking or skids, and prevent soiling or staining. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- G. Store finished products that are ready for installation in dry and well ventilated areas.

3.3 INSTALLATION

- A. Install in accordance with Manufacturer's written instructions.
- B. Install equipment anchors, supports, and seismic bracing per the requirements of the Manufacturer, as indicated on Drawings, and consistent with the Seismic requirements of the project.
- C. Prior to assembly all stainless steel bolts and nut threads shall be coated with a non-seizing compound by the Contractor.
- D. Anchor Bolts: Accurately place using equipment templates.

- E. Support and securely anchor equipment and appurtenances. Process connections shall be plumb and tight.
- F. CONTRACTOR shall rely on Manufacturer for installation and startup assistance.
- G. CONTRACTOR shall coordinate scheduling of Manufacturer trip to the jobsite in Kenai, Alaska with OWNER and Manufacturer.
- H. Install electrical power circuits, instrumentation and control wiring and associated raceways as shown on the Drawings and required by Division 26 ELECTRICAL.
- I. Install all control and electrical equipment as per the manufacturer's recommendations and to provide operation as described in Section 40 90 00 PROCESS INSTRUMENTATION AND CONTROLS, and as shown on the Drawings.
- J. Prior to start-up of the facility, inspect, test, and document that the electrical and control systems are operational.
- K. Calibrate components including but not limited to: analog devices, discrete devices, controllers, I/O modules, and switches.
- L. Upon completion of installation and prior to equipment functional and performance testing, CONTRACTOR shall thoroughly clean structures, equipment, pipe, and related appearances free of all construction debris, trash and other materials that may be detrimental to the operation equipment in this specification.

3.4 FIELD QUALITY CONTROL

- A. Functional and Performance Testing:
 - 1. Conduct on equipment under actual or approved simulated operating conditions.
 - a. Test for a continuous 3-hour period without malfunction.
 - b. Verify correct operation of all control and alarm functions.
 - c. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - 2. Operating Temperatures: Monitor bearing areas on equipment and motor for abnormally high temperatures.
 - 3. Test Log: Record the following:
 - a. Horsepower requirements.
 - b. Driving motor voltage and amperage measured for each phase.
 - c. Function of Emergency Stop

3.5 RECORD DRAWINGS

- A. CONTRACTOR shall maintain a current set of construction drawings and specifications that reflect any changes, modifications, clarifications, additions, or deletions from the Contract Documents per specification Section 01 78 39 PROJECT RECORD DOCUMENTS. Annotations shall include any CONTRACTOR issued equipment or wiring identification tags and/or numbers. Record drawing information shall be provided to the OWNER at the completion of system start up and substantial completion.

3.6 MANUFACTURER'S SERVICES

- A. Installation Inspection: Prior to system start up, the Equipment Supplier shall inspect the installation of the equipment including instrumentation, and control and power wiring to verify system installation is satisfactory for operation.
- B. Startup Services: The Equipment Supplier shall provide a technical representative to the project site to observe the startup of the equipment, make adjustments to the equipment, and troubleshoot problems with the equipment as needed.
 - 1. Operator Training: The Equipment Supplier shall provide a minimum of 4 hours of training at the project site to review the Operations and Maintenance (O&M) Manuals for the project with the operations personnel.
 - a. O&M Manuals used for the training must have prior approval by OWNER through the submittal process prior to use in the training.
 - b. Equipment Supplier to provide OWNER signatures of operators attending the training certifying they have completed the training provided for the project.
- C. Notify OWNER and Manufacturer in writing, 10-days prior to the date when the installation will be ready for inspection.

3.7 TROUBLESHOOTING SERVICES

- A. If equipment and system do not meet manufacturer's published performance ratings or the requirements of this specification, CONTRACTOR and Manufacturer/Manufacturer's Representative shall provide troubleshooting services to identify the cause of the problem and correct the problem.
- B. If performance problems are due to defects in the work installed by the CONTRACTOR, CONTRACTOR shall correct the defective work at no cost to OWNER.
- C. If equipment does not meet performance requirements due to material or workmanship defects in the equipment, CONTRACTOR shall, with the assistance of the Manufacturer/Manufacturer's Representative for that equipment, identify the fault and recommend repair and/or replacement of the faulty component or components to OWNER at no cost to OWNER.

3.8 FIELD FINISHING AND TOUCHUP

- A. Provide field finishing and touchup as recommended by the Manufacturer.

3.9 FINAL CLEAN

- A. Clean surfaces in accordance with Manufacturer's written instructions.

END OF SECTION 46 33 33

SECTION 46 41 41 – TANK MIXER EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, functional test, and provide startup services for tank mixer equipment complete and functional with electrical and control systems, as specified herein and as shown on the Drawings.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract, Supplementary General Conditions, and Division 01 - General Requirements apply to Work of this Section.
- B. 01 10 00 – Summary
- C. 01 14 00 – Project Constraints
- D. 01 33 00 – Submittal Procedures
- E. 01 60 00 – Product Requirements
- F. 01 75 00 – Starting and Adjusting
- G. DIVISION 26 – Electrical
- H. 40 33 33 – Polymer Blending and feed Equipment
- I. 40 90 00 – Process Instrumentation and Controls

1.3 QUALITY ASSURANCE

- A. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL), Factory Mutual (FM), or other Nationally Recognized Testing Laboratory (NRTL) suitable to the State of Alaska.
- B. All parts and components shall be of a single manufacturer and designed as a single system.

1.4 SUBMITTALS

- A. Prepare, deliver, and process under provisions of Section 01 33 00 SUBMITTAL PROCEDURES. Requests for proposed substitute or “or-equal” equipment/systems/products will be considered in accordance with Section 01 25 00 SUBSTITUTION PROCEDURES.
- B. Complete list of all deviations from the Drawings and Specifications.

- C. Shop Drawings. Provide the following:
1. Product data and cut sheets for make and model of components intended for use in the work.
 2. Product dimensional information for equipment and components to be used in this Project
 3. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 4. Installation, Operations and Maintenance manuals. Including Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
 5. Seismic: Provide seismic design calculations submittal for design of structural support for mixer and seismic anchor support for assembly prepared and stamped by Alaska registered structural engineer.

PART 2 - PRODUCTS

2.1 TANK MIXER (MXR-5-1)

- A. Function: Provide low speed low shear intermittent mixing of neat polymer stored in Polymer Storage Tank T-5-1.
- B. Tank Characteristics
1. Upright vertical centrifugal storage tank,
 2. 500 gallons nominal capacity
 3. Side water depth up to 60 inches
 4. Tank diameter of 48 inches
- C. Tank Liquid Contents
1. Neat Polymer Product, SNF Polydyne C-6276
 2. 45 to 65 degrees F temperature
 3. Neat viscosity 500 to 2000 cPs
 4. Density 8.5 to 8.7 lbs/gallon
- D. Mixer assembly to consist of
1. Electric motor drive features
 - a. Motor operating in unclassified area.

- b. NEMA standard C face design. UL rated. NEMA B temperature rise.
 - c. Motor ball bearings to be permanently lubricated double sealed and mechanically or chemically clamped.
 - d. Inverter duty service with minimum class F winding insulation.
 - e. Fabricated motor shaft and mixer drive shaft assembly to be concentric to minimize bearing radial loadings.
- 2. Gear reduction unit
 - a. Inline planetary gear assembly, designed for continuous operational duty.
 - b. Anti-rotation pins positioned with sufficient float to allow ring gear to self-center
 - c. Gears to have AGMA service factor of 1.5 or greater.
 - d. Lubricated with lifetime synthetic grease.
 - e. Drive shaft attachment to mixer to be by rigid coupling fabricated of stainless steel. Coupling halves to be machined for concentricity. Safety guards provided for couplings.
- 3. Mixer drive shaft
 - a. Centerless ground and finished for straightness and cleanliness.
 - b. Fabricated of 316L stainless steel.
 - c. Total indicated shaft run out less than 2 millimeters per meter of shaft length when turned by hand.
- 4. Mixer impellers
 - a. Low speed high efficiency axial flow with constant discharge velocity across impeller diameter.
 - b. Attached to the immersed end of mixer drive shaft with set screws
 - c. Fabricated of 316L stainless steel
- 5. Provide flexible coupling between gearmotor drive assembly and mixer drive shaft
- 6. Provide flange mounting to fasten mixer assembly to supporting structural frame spanning Tank T-5-1.
- 7. Provide structural frame for mixer assembly
 - a. Frame to support mixer operations under all liquid level and mixer speed conditions, compatible with seismic requirements for the Project site and secured to the concrete floor of the building with seismic anchor bolts.

- b. Frame to be fabricated of welded and/or bolted structural channel and plate steel shapes treated with hot dipped galvanizing prior to arrival at the Project site.
- E. Performance: Mix tank contents at a turnover rate of once per 10 minutes
- F. Manufacturers and Products:
 - 1. SPX Flow Lightnin top entry mixer model 15Q1, or approved equal with a 1.0 hp motor

PART 3 - EXECUTION

3.1 FUNCTIONAL AND PERFORMANCE VERIFICATION

- A. Initiate operation of Mixer MXR-5-1 from Polymer Local Control Panel LCP-5-1. See Section 40 90 00 PROCESS CONTROL AND INSTRUMENTATION SYSTEMS and PID drawings.
- B. Verify rotation of mixer provide pumping direction as recommended by mixer manufacturer.
- C. Coordinate mixer selection and operational characteristics with Polymer Manufacturer (SNF Polydyne).

3.2 INSTALLATION

- A. Install as shown on the Drawings, and per the Mixer Manufacturer's instructions.
- B. Supports: Provide all hangers, supports, guides, anchors, bolts, and mounting accessories as required for the installation and as approved for use in the work.

END OF SECTION 46 41 41

SECTION 46 71 46 - SCREW PRESS (OWNER PROCURED)

PART 1 - PART 1 GENERAL

1.1 WORK INCLUDED

- A. OWNER has procured a digested sludge dewatering Screw Press which includes, but is not limited to screw press, air compressor for pneumatic controls, flocculation tank and mixer, screw press control panel, special tools and spare parts, and Manufacturer's site services for commissioning, as described herein and as shown on the Drawings. Screw Press equipment shall be furnished to the CONTRACTOR for installation.
- B. CONTRACTOR shall receive delivery of the Screw Press and appurtenances at the location confirmed by the OWNER in Kenai, Alaska; Wastewater Treatment Plant and provide unloading as required. Upon receipt of the equipment, CONTRACTOR assumes possession of the equipment and shall provide suitable storage per the Manufacturer's recommendations, at a location as designated in these Documents, or as otherwise suitably arranged by CONTRACTOR.
- C. CONTRACTOR shall install the Screw Press and appurtenances; including interconnecting piping, valves, electrical and control wiring, structural equipment supports, and pipe supports, complete and functional, per the Screw Press Manufacturer's (SP MANUFACTURER's) written instructions and recommendations, as shown on the Drawings, and as described herein.

1.2 DEFINITIONS

- A. CONTRACTOR. The Contractor shall be the General Construction Contractor selected through the process outlined in this bid document set.
- B. SP MANUFACTURER (Supplier). The SP Manufacturer is the Supplier, *ANDRITZ Separation*; competitively selected by OWNER, from which OWNER has procured the Screw Press and appurtenances, delivery to site, and Manufacturer's site services for commissioning, that are the subject of this Specification.

1.3 RELATED SECTIONS

- A. Standard General Conditions, Supplementary Conditions, and Division 1 - General Requirements apply to work of this Section.
- B. 01 31 00 – Project Management and Coordination
- C. 01 32 00 – Construction Progress Documentation
- D. 01 33 00 – Submittal Procedures
- E. 01 43 33 - Manufacturer's Field Services
- F. 01 75 00 – Starting and Adjusting

- G. 02 41 19 – Selective Demolition
- H. 03 30 00 – Cast in Place Concrete
- I. DIVISION 26 – Electrical
- J. DIVISION 40 – Process Interconnections
- K. 40 05 01 – Process Piping
- L. 41 12 13.36 – Screw Conveyor
- M. 43 23 00 – Process Pumps
- N. 46 33 33 – Polymer Blending and Feed Equipment

1.4 REFERENCES

- A. Current versions and adopted version of:
 - 1. International Conference of Building Officials (ICBO).
 - 2. International Building Code (IBC).
 - 3. International Plumbing Code (IPC)
 - 4. National Electric Code (NEC)
 - 5. Alaska Administrative Code: 18AAC72 Wastewater Discharge

1.5 SUBMITTALS

- A. Prepare, deliver, and process under provisions of Section 01 33 00 SUBMITTAL PROCEDURES.
- B. Complete list of all deviations from the Drawings and Specifications.
- C. Shop Drawings. Provide Submittals for review and approval prior to procurement of materials or initiation of fabrication appurtenant to and supporting the installation and commissioning of the Screw Press.
 - 1. Drawings that include dimensioned outlined drawings, cut-away drawings, parts lists, and material lists.
 - 2. Seismic structural and anchorage calculations and details stamped and sealed by a Professional Engineer registered in the state of Alaska.
 - 3. Installation and checkout instructions including leveling and alignment tolerances, grouting, and initial start-up procedures.
 - 4. Detailed description of the Acceptance Testing

- D. Quality Control. Provide the following:
1. SP MANUFACTURER's certificates of proper installation, operation, and training.
 2. Testing Reports
 3. Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 DESIGN/CONSTRUCTION REQUIREMENTS

- A. Provide systems, equipment, and components, including supports and anchorages, in accordance with the provisions of the most current version of the International Building Code (IBC) as amended by the City of Kenai.
- B. Seismic Restraint, Load and Design: Per the requirements detailed on the Structural drawings.
- C. Area Classification: Unclassified. Unless noted otherwise on a Code Analysis Drawing.

2.2 OWNER PROCURED SCREW PRESS MANUFACTURER (SUPPLIER) AND EQUIPMENT

- A. ANDRITZ Separation; Screw Press Model C-5427
1. Reference SP Manufacturer's submittal documents, included in the Appendix to the Technical Specifications, which describe the scope of supply and services SP MANUFACTURER is required to provide to OWNER/CONTRACTOR for this Work.
 2. Design Criteria
 - a. Aerobically Digested Sludge:
 - 1) Feed Solids Concentration: 1.0 – 1.6% total solids
 - 2) Feed Solids Capacity: 240 pounds/hour
 3. Performance Requirements
 - a. Cake Solids Concentration: 15-16% total solids (or passing the Paint Filter Liquids Test)
 - b. Solids Capture: 93-95% total solids
 - c. Polymer Dosage (Emulsion): 20-30 active pounds per dry ton of feed solids
 4. Flocculation Tank and Mixer
 - a. 140 gallon, 304 stainless steel tank and mixing shaft with blades. 1 Hp Nord motor. Polymer injection ring.

5. Screw Press Control Panel
 - a. NEMA 4X (304 stainless steel)
 - b. Power: 480 VAC, 3 phase, 60 Hz
6. Special Tools and Spare Parts
 - a. One (1) set of Special Tools
 - b. One (1) set bearings and bushings
 - c. One (1) set wipers and mounting hardware
 - d. One (1) set shower spray nozzles

2.3 CONTROL

- A. Screw Press Sequence of Operation (SEQ) / Control System Description (CSD) is included in the Appendix to the Technical Specifications.
- B. See Specification Section 40 90 00 PROCESS INSTRUMENTATION AND CONTROLS for additional requirements.

2.4 ACCESSORIES

- A. Anchor Bolts: Type 316 stainless steel, as per Manufacturer's recommendations.
- B. Equipment Identification Plates: Contractor shall provide a 16-gauge stainless steel identification plate shall be securely mounted on the equipment in a readily visible location. The plate shall bear the ¼-inch die-stamped equipment name and identification number indicated in this Specification and shown on the Drawings.

2.5 LUBRICANTS

- A. CONTRACTOR shall furnish all lubricants required for startup, initial operation, and testing of the equipment as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 STORAGE AND HANDLING

- A. Receive OWNER procured Screw Press and appurtenances at the location confirmed by the OWNER in Kenai, Alaska; Wastewater Treatment Plant.
- B. Unload products in accordance with Manufacturer's instructions. Record the receipt of products at the site.

- C. CONTRACTOR shall jointly inspect Screw Press and appurtenant equipment with OWNER. Any damaged items shall be replaced by SP MANUFACTURER as coordinated by CONTRACTOR.
- D. CONTRACTOR assumes possession of the equipment and shall provide suitable storage per the SP MANUFACTURER's recommendations [or Store delivered products at the Wastewater Treatment Plant where directed by OWNER] and the following:
 - 1. Store equipment in clean, dry, well-ventilated area. Protect equipment from damage and freezing and provide heated storage.
 - 2. Control components shall be protected from corrosion. Store equipment with corrosion-inhibitor systems.
 - 3. Cover equipment, panels, and other elements to protect from dust during construction.

3.2 INSTALLATION

- A. Equipment shall be installed in accordance with SP MANUFACTURER's written instructions and recommendations. Exercise care when handling equipment to avoid damage to finished materials and components of the system.
- B. Install equipment anchors, supports, and seismic bracing per the requirements of the Manufacturer and as indicated on Drawings.
- C. Connect inlet and outlet piping without imposing strain to inlet and outlet flanges.
- D. CONTRACTOR shall furnish and install power sources and protective devices, power and control conductors, raceways/conduits, interconnecting cables including grounding per NEC, and equipment base supports; as shown on the Drawings, and per the requirements of the Specifications.
- E. Install all control and electrical equipment as per the SP MANUFACTURER's recommendations and provide operation as described in the Control Drawings and Specifications.
- F. Terminate all wiring entering or leaving enclosures at numbered terminal blocks. Permanently label all ends of cables and conductors at terminations. Labels to be identical to circuit identification used in Project record wiring diagrams.
- G. CONTRACTOR shall field modify SP MANUFACTURER supplied interconnecting conduit to suitable length, as required.
- H. Identify all wiring using circuit schedule designations, at each termination and in accessible locations such as panels, switchboards, pull boxes, and terminal boxes.
- I. Prior to Start-up of the Screw Press and appurtenances, inspect, test, and document that the entire automated control system is operational.
- J. Calibrate and configure all process components and instruments including but not limited to pressure, temperature, flow instrumentation, on-line analyzers, controllers, I/O modules, and switches.

- K. Furnish signal isolation for analog signals sent from one enclosure to another. Do not wire instruments on different panels, cabinets, or enclosures in series.

3.3 FIELD QUALITY CONTROL

- A. Functional Test: Prior to Screw Press startup and commissioning, perform functional checkout. All equipment shall be inspected for proper alignment, connection, operation, and function.
- B. SP MANUFACTURER shall be responsible for verification of installation including conductors, electrical hookup of equipment, startup, testing, and operation and maintenance instruction of the OWNER's personnel.
- C. Test process instrument and control system elements per specification Section 01 75 00 STARTING AND ADJUSTING, to demonstrate the system meets the control requirements as depicted on the Drawings and as described by the SP MANUFACTURER and specification Section 40 90 00 PROCESS INSTRUMENTATION AND CONTROLS.
- D. Assist OWNER in providing performance testing of screw press equipment per specification Section 01 75 00 STARTING AND ADJUSTING.

3.4 RECORD DRAWINGS

- A. CONTRACTOR shall maintain a current set of construction drawings and specifications that reflect any changes, modifications, clarifications, additions, or deletions from the Contract Documents per specification Section 01 78 39 PROJECT RECORD DOCUMENTS. Annotations shall include any CONTRACTOR issued equipment or wiring identification tags and/or numbers. Record drawing information shall be provided to the OWNER at the completion of system start up and substantial completion.

3.5 MANUFACTURER'S SERVICES

- A. The OWNER procured Screw Press and appurtenances includes the SP MANUFACTURER's site services for commissioning to CONTRACTOR/OWNER for Installation, Operation and Maintenance Manual, Startup assistance and Functional Performance.
- B. A Manufacturer's trained specialist, experienced in the installation of the equipment specified, and with at least five (5) years of field experience shall be present at the job site and / or classroom designated by the OWNER/CONTRACTOR for one (1) trip of five (5) days duration to provide the following services:
 - 1. Installation Inspection: Prior to system start up, the SP MANUFACTURER shall inspect the installation of the equipment including process piping, instrumentation, control, foundation, and electrical service to verify system installation is satisfactory for operation.
 - 2. Startup and Commissioning, and Testing: The SP MANUFACTURER shall provide a technical representative to the project site to startup and commission, and test the Screw Press, verify all functions of the equipment, make adjustments to the equipment, and troubleshoot problems with the equipment as needed to meet the performance goals of this section.

3. Operator Training: The SP MANUFACTURER shall provide a minimum of 8 hours of training at the project site to review the Operations and Maintenance (O&M) Manuals for the project with the operations personnel.
4. O&M Manuals used for the training must have prior approval by the OWNER through the submittal process prior to use in the training.
5. Equipment Supplier to provide OWNER signatures of operators attending the training certifying they have completed the training provided for the project.

3.6 TROUBLESHOOTING SERVICES

- A. If equipment and system do not meet manufacturer's published performance ratings or the requirements of this specification, CONTRACTOR and SP MANUFACTURER's Representative shall provide troubleshooting services to identify the cause of the problem.
- B. If performance problems are due to defects in the work installed by CONTRACTOR, CONTRACTOR shall correct the defective work at no cost to OWNER.
- C. If equipment does not meet the SP MANUFACTURER's performance criteria due to material or workmanship defects in the equipment, CONTRACTOR shall, with the assistance of the SP MANUFACTURER's Representative for that equipment, identify the fault and recommend repair and/or replacement of the faulty component or components to OWNER.

3.7 FIELD FINISHING AND TOUCHUP

- A. Provide field finishing and touchup as recommended by the Manufacturer.

3.8 FINAL CLEAN

- A. Provide final cleaning of surfaces in accordance with manufacturer's printed instructions.

END OF SECTION 46 71 46

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