

TECHNICAL SPECIFICATIONS
FOR
CITY OF UNALAKLEET
2019 WATER TREATMENT PLANT UPGRADES

Issued for Construction

July 2020

Prepared for:
State of Alaska
Department of Environmental Conservation
Village Safe Water Program
and
The City of Unalakleet

Prepared by:
CRW Engineering Group, LLC.
3940 Arctic Blvd, Suite 300
Anchorage, AK 99503

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Issued by CRW Engineering Group, LLC

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DIVISION 01 GENERAL REQUIREMENTS

SECTION 01 11 13
WORK COVERED BY CONTRACT DOCUMENTS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Work Covered by Contract Documents
- B. Description of Bid Items
- C. Contract Method
- D. Work By Others
- E. Shutoffs, Disruptions to Service
- F. Contractor's Use of Premises
- G. Coordination
- H. Access for Testing and Inspection

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Work under this Contract consists of improvements at the City of Unalakleet Water Treatment Plant including upgrades to the existing recovered heat system, installation of a high turbidity raw water bypass system, replacing/upgrading water treatment instrumentation, installation of a new backup generator, building electrical service and various electrical system improvements, etc.

1.3 DESCRIPTION OF BID ITEMS

1.3.1 Water Treatment Plant Upgrades:

- 1. See Appendix B – Scope of Services

1.4 CONTRACT METHOD

- A. This is a lump sum contract.

1.5 WORK BY OTHERS

- A. Other projects may run concurrently with the work. Cooperate with other contractors, force account construction crews and superintendents, agencies and the OWNER to minimize conflicts.
- B. Notify the Engineer immediately if conflicts will interfere with the progress of the work.

1.6 SHUTOFFS / DISRUPTIONS TO SERVICE

- A. No disruptions to WTP power or water production shall be allowed without written approval from the City and the Engineer. Under no circumstances shall the duration of any disruptions in service exceed 8 hours. Contractor shall be responsible for providing temporary services whenever necessary to prevent harm to City owned facilities throughout construction.
- B. Work with the OWNER to schedule any disruptions for a time which minimizes impact on facility operations. Provide not less than 72 hours' notice to OWNER of activities that will affect building power, heat, or water treatment related operations.

1.7 CONTRACTOR'S USE OF PREMISES

- A. Coordinate with OWNER prior to placing equipment or supplies at the staging area(s) identified on the Contract Drawings. Do not disturb areas outside of project boundaries.
- B. Do not disrupt access to adjacent areas unaffected by the Work. Keep driveways and entrances serving premises clear and available for use at all times. Cooperate with OWNER during construction operations to minimize conflicts and facilitate OWNER operations.
- C. Assume full responsibility for protection and safekeeping of products under this Contract.
- D. Assume full responsibility for the protection of existing facilities and contents, from damage due to construction operations.

1.8 COORDINATION

- A. Coordinate Work to ensure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.
- B. Sequence Work to maximize worker efficiency and minimize construction time.
- C. Prior to procurement verify that characteristics of interrelated equipment are compatible.
- D. Coordinate space requirements and installation of components. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

1.9 ACCESS FOR TESTING AND INSPECTION

- A. Provide access for OWNER and Engineer to the site. Provide on-site transportation, ladders, lifts, eye and ear protection, hard hats, appropriate and clean respiratory protection, etc., for inspections and testing of the work.

PART 2 – PRODUCTS

Not Used

Part 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 11 17

INTENT OF DOCUMENTS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Explanation of intent and terminology of the Construction Documents.

1.2 RELATED REQUIREMENTS

- A. Section 00 72 13 General Conditions: Article 1 Definitions relating to 'Drawings' and 'Specifications'.
- B. Section 00 72 13 General Conditions: Article 3 Contract Documents relating to Intent, Amending, and Reuse.

1.3 SPECIFICATION FORMAT AND COMPOSITION

- A. Specifications are divided into Divisions and Sections for the convenience of writing and using. Titles are not intended to imply a particular trade jurisdiction. The Owner is not bound to define the limits of any subcontract, and will not enter into disputes between the Contractor and his employees, including Subcontractors.
- B. Pages are numbered independently for each section, and recorded in the Table of Contents. Section number is shown with the page number at the bottom of each page. The end of each section of the specifications is ended by "End of Section". It is Contractor's responsibility to verify that Contract Documents received for bidding and/or construction are complete in accordance with Table of Contents.
- C. The language employed in the Contract Documents is addressed directly to the Contractor. Imperative or indicative language is generally employed throughout and requirements expressed are the mandatory responsibility of the Contractor, even though the work specified may be accomplished by specialty subcontractors engaged by the Contractor. References to third parties in this regard shall not be interpreted in any way as to relieve the Contractor of his or her responsibility under this Contract.
- D. These Specifications are of the abbreviated, or "streamlined" type, and may include incomplete sentences.
- E. Omissions of words or phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the Drawings", "according to the Drawings", "a", "an", "the", and "all" are intentional.
- F. Omitted words or phrases shall be supplied by inference in the same manner as they are when a "note" occurs on the Drawings.

1.4 DRAWINGS: CONTENT EXPLANATION

- A. Drawings, Dimensions, and Measurements.
 - 1. Contract Documents do not purport to describe in detail, absolute and complete construction information. Drawings are diagrammatic. Contractor shall provide verification of actual site conditions and shall provide complete and operational systems as specified when drawings do not provide full detail.

1.5 COMMON TERMINOLOGY

- A. Certain items used generally throughout the Specifications and Drawings are used as follows:
 - 1. Indicated: The term "indicated" is a cross reference to details, notes or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar means of recording requirements in the Contract Documents. Where terms such as "shown", "noted", "schedules", and "specified" are used in lieu of "indicate", it is for the purpose of helping the reader accomplish the cross reference, and no limitation of location is intended except as specifically noted.
 - 2. Installer: The person or entity engaged by Contractor or subcontractors for the performance of a particular unit of Work at the Project site, including installation, erection, application, and similar required operations. It is a general requirement that installers be recognized experts in the work they are engaged to perform.
 - 3. Furnish: Except as otherwise defined in greater detail, the term "furnish" is used to mean "...supply and deliver to the Project site, ready for unpacking, assembly and installation..."
 - 4. Provide: Except to the extent further defined, the term "provide" means to furnish and install, complete and ready for the intended use.
 - 5. Guarantee and Warranty: "Guarantee" is generally used in conjunction with units of work which require both products and substantial amounts of labor at the Project site. "Warranty" is generally used in conjunction with products manufactured or fabricated away from the Project site. The resulting difference is that warranties are frequently issued by manufacturers, and guarantees are generally issued by Contractor and frequently supported (partially) by product warranties from manufacturers.

1.6 CONFLICTS

- A. Report any conflicts to the Engineer for clarification.

PART 2 – PRODUCTS

Not Used

Part 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 11 21**CONTRACTOR'S CERTIFICATION OF SUBCONTRACTORS****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Procedures for preparing, submitting, and accepting subcontracts.

1.2 RELATED REQUIREMENTS

- A. Document 00 21 13 Information to Bidders
- B. Document 00 43 36 Subcontractor List
- C. Document 00 72 13 General Conditions
- D. Section 01 33 00 Submittals: Procedures

1.3 PREPARATION

- A. Certification Forms: Use forms provided in Section 00 43 36.
- B. Contractor to prepare certification form and submit to the OWNER prior to the start of work. Multiple subcontracts may be included under a single submittal. Where required, attach additional information (cross-referenced to the appropriate subcontract) to the certification form.
- C. Substitute certification forms will not be considered.

1.4 SUBMITTAL OF CERTIFICATION

- A. Contractor shall submit the initial and all subsequent certification forms in accordance with the submittal requirements identified under paragraph 1.2 D of this Section.

1.5 CONSIDERATION OF CERTIFICATION

- A. Following receipt of submittal and within a reasonable period of time the Owner shall review for each of the following:
 - 1. Completeness of forms and attachments.
 - 2. Proper execution (signatures) of forms and attachments.
- B. Submittals which are not complete or not properly executed will be returned to the Contractor under a transmittal letter denoting the deficiencies found. Contractor shall correct and resubmit per paragraph 1.4 of this Section.

1. Subcontractors will be required to leave the Project site until properly executed subcontract is in place.
2. Payment will not be made for work performed by a non-certified subcontractor.

1.6 ACKNOWLEDGMENT OF CERTIFICATION

- A. Submittals which have been examined by the OWNER and are determined to be complete and properly executed shall be acknowledged as such by signature of designated OWNER representative on the face of each certification form.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 20 13**APPLICATION FOR PAYMENT****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Procedures for preparation and submittal of Applications for Payment.

1.2 RELATED REQUIREMENTS

- A. Section 00 72 13 General Conditions
- B. Section 01 33 00 Submittals
- C. Section 01 29 73 Schedule of Values.
- D. Section 01 77 19 Closeout Requirements.
- E. Section 01 78 39 Project Record Documents.

1.3 FORMAT

- A. Application for Payment form as provided by OWNER or Contractor's form containing same information.

1.4 PREPARATION OF APPLICATIONS

- A. Type required information on Application for Payment form approved by OWNER.
- B. Execute certification by original signature of authorized officer upon each copy of the Application for Payment.
- C. Submit names of individuals authorized to be responsible for information submitted on Application for Payment.
- D. Indicate breakdown of costs for each item of the Work on accepted schedule of values. Provide dollar value in each column for each line item for portion of Work performed and for stored products.
- E. List each authorized Change Order as an extension on continuation sheet, listing Change Order number and dollar amount as for an original item of Work.
- F. Include 10% retainage on each pay request. Retainage shall be eligible for payment on Contractor's final pay request.
- G. Prepare Application for Final Payment as specified in Section 01 77 19 Closeout Requirements.

1.5 SUBMITTAL PROCEDURES

- A. Submit one copy of each Application for Payment at times stipulated in Contract.
- B. Submit under OWNER accepted transmittal letter. See Section 01 29 73 Schedule of Values. Identify Contract by the OWNER contract number.

1.6 SUBSTANTIATING DATA

- A. When OWNER requires substantiating information, submit data justifying line item amounts in question.
- B. Provide one copy of data with cover letter for each copy of Application for Payment. Show Application for Payment number and date, and line item by number and description.

1.7 SUBMITTALS WITH APPLICATION FOR PAYMENT

- A. Submit the following with each Application for Payment.
 - 1. Updated construction schedule as required by Section 01 33 00 Submittals.
 - 2. Updated Schedule of Values as required by Section 01 29 73 Schedule of Values.
 - 3. Evidence of transmittal of certified payrolls, if required, to the Labor Department.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 25 13**PRODUCT OPTIONS AND SUBSTITUTIONS****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Requests for substitution of products.

1.2 RELATED REQUIREMENTS

- A. Section 00 11 16 Invitation For Bids: Substantial Completion Date.
- B. Section 00 72 13 General Conditions.
- C. Section 00 73 13 Supplementary Conditions.
- D. Section 01 33 00 Submittals.
- E. Section 01 33 23 Shop Drawings, Product Data, and Samples.

1.3 SUBSTITUTION SUBMITTAL PERIOD

- A. All product substitution requests will be considered only within 15 days after date established in Notice to Proceed. Subsequent requests will be considered only in case of product unavailability or other conditions beyond control of Contractor.

1.4 OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards.
- B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not specifically named.
- C. Products Specified by Naming One or More Manufacturers followed by the term "No Substitutions": use only specified manufacturers, no substitutions allowed.

1.5 PRODUCTS LIST

- A. Within (15) days after date of Notice to Proceed, transmit an electronic copy of a list of products which are proposed for installation, including name of manufacturer.
- B. Tabulate products by Specifications section number, title, and Article number
- C. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

- D. Engineer will reply in writing within fifteen days stating whether there is reasonable objection to listed items. Failure to object to a listed item shall not constitute a waiver of requirements of Contract Documents.
- E. Owner will contact Engineer to ascertain any extra Professional fees to assess the substitutions and shall so notify Contractor who will include payment for the professional review cost in the application for substitution.

1.6 LIMITATIONS ON SUBSTITUTIONS

- A. Substitutions will not be considered when indicated on Shop Drawings or product data submittals.
- B. Substitute products shall not be ordered or installed without written acceptance.
- C. Owner will contact the Engineer to determine acceptability of substitutions.

1.7 REQUESTS FOR SUBSTITUTIONS

- A. Submit separate request for each substitution. Document each request with complete data substantiating compliance of proposed substitution with requirements of Contract Documents.
- B. Identify product by Specification section and Article numbers. Provide manufacturer's name and address, trade name of product, and model or catalog number. List fabricators and Suppliers as appropriate.
- C. Attach product data as specified in Section 01 33 23.
- D. List similar projects using product, dates of installation, and names of design Engineer(s) and, name of the facility OWNER.
- E. Give itemized comparison of proposed substitution with specified product, listing variations, and reference to Specification sections and Article numbers.
- F. Give quality and performance comparison between proposed substitution and the specified product.
- G. Give cost data comparing proposed substitution with specified product, and amount of net change to Contract Price.
- H. List availability of maintenance services and replacement materials.
- I. State effect of substitution on construction schedule, and changes required in other Work or products.

1.8 CONTRACTOR REPRESENTATION

- A. Request for substitution constitutes a representation that Contractor has investigated proposed product and has determined that it is equal to or superior in all respects to specified product.

- B. Contractor will provide same warranty for substitution as for specified product.
- C. Contractor will coordinate installation of accepted substitute, making such changes as may be required for Work to be complete in all respects.
- D. Contractor certifies that cost data presented is complete and includes all related costs under this Contract.
- E. Contractor waives claims for additional costs related to substitution which may later become apparent.

1.9 SUBMITTAL PROCEDURES

- A. Submit an electronic copy of complete request for substitution.
- B. Project Manager will review Contractor's requests for substitutions with reasonable promptness.
- C. During the bidding period, OWNER will record acceptable substitutions in Addenda.
- D. After Award of Contract, OWNER will notify Contractor, in writing, of decision to accept or reject requested substitution within 15 days.
- E. For accepted products, submit Shop Drawings, product data, and samples under provisions of Section 01 33 23.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

PART 4 - BASIS OF MEASUREMENT AND PAYMENT

4.1 BASIS OF MEASUREMENT

- A. There is no measurement for this item.

END OF SECTION

SECTION 01 26 57**CHANGE ORDER PROCEDURES****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Procedures for processing Change Orders.

1.2 RELATED REQUIREMENTS

- A. Section 00 41 15 Bid Schedule
- B. Section 00 52 13 Construction Contract: Total amount of Contract Price, as awarded
- C. Section 00 72 13 General Conditions
- D. Section 01 20 13 Application for Payment.
- E. Section 01 33 00 Submittals: Progress Schedules.
- F. Section 01 29 73 Schedule of Values.
- G. Section 01 77 19 Closeout Requirements.

1.3 SUBMITTALS

- A. Submit name of the individual authorized to accept changes, and to be responsible for informing others in Contractor's employ of changes in the Work.
- B. Change Order forms will be prepared by OWNER.

1.4 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

- A. Maintain detailed records of work done on a Cost of the Work basis. Provide full information required for evaluation of proposed changes, and to substantiate costs of changes in the Work. Incomplete or unsubstantiated costs will be disallowed.
- B. Contractor shall submit a complete, detailed, itemized cost breakdown addressing impact on Contract Time and Contract Price with each proposal.
- C. On request, provide additional data to support computations:
 - 1. Quantities of products, labor, and equipment.
 - 2. Taxes, insurance, and bonds.
 - 3. Justification for any change in Contract Time.
 - 4. Credit for deletions from Contract, similarly documented.

- D. Support each claim for additional costs, and for work done on a Cost of the Work basis, with additional information:
 - 1. Origin and date of claim.
 - 2. Dates and times work was performed and by whom.
 - 3. Time records and wage rates paid.
 - 4. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

1.5 PRELIMINARY PROCEDURES

- A. OWNER may submit a Proposal Request which includes: Detailed description of change with supplementary or revised Drawings and Specifications, the projected time for executing the change, with a stipulation of any overtime work required, and the period of time during which the requested price will be considered valid.
- B. Contractor may initiate a change by submittal of a request to OWNER describing the proposed change with a statement of the reason for the change, and the effect on Contract Price and Contract Time with full documentation.

1.6 CONSTRUCTION CHANGE AUTHORIZATION

- A. Shall be in accordance with Article 9 - Changes: in Section 00 72 13 - General Conditions.

1.7 LUMP SUM CHANGE ORDER

- A. Contractor shall submit an itemized price proposal in sufficient detail to fully explain the basis for the proposal. Contractor and OWNER shall then negotiate an equitable price (and time adjustment if appropriate) in good faith. The Change Order will reflect the results of those negotiations. If negotiations break down, Contractor may be directed to perform the subject Work under a COST OF THE WORK CHANGE ORDER.
- B. The maximum rates of cost markup (to cover both overhead and profit of the Contractor) shall be in accordance with Article 10- Contract Price, Computation and Change: in Section 00 72 13 – General Conditions.
- C. These terms shall also apply to the proposals of subcontracts and allowances.

1.8 UNIT PRICE CHANGE ORDER

- A. For pre-determined unit prices and quantities, Change Order will be executed on a lump sum basis.

- B. For pre-determined unit prices and undetermined quantities, Change Order will be executed on an estimated quantity basis; payment will be based on actual quantities measured as specified.

1.9 COST OF THE WORK CHANGE ORDER

- A. Contractor shall submit documentation required in Paragraph 1.4 of this Section on a daily basis for certification by OWNER. OWNER will indicate by signature that the submitted documentation is acceptable. If it is not acceptable, Contractor and OWNER shall immediately meet to discuss resolution.
- B. After completion of the change and within 14 calendar days, unless extended by OWNER, the Contractor shall submit in final form an itemized account with support data of all costs. Support data shall have been certified by OWNER, as required above in paragraph A.
- C. OWNER will determine the change allowable in Contract Price and Contract Time as provided in provisions of the Contract Documents.

1.10 EXECUTION OF CHANGE ORDERS

- A. OWNER will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

1.11 CORRELATION OF CONTRACTOR SUBMITTALS

- A. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price as shown on Change Order.
- B. Promptly revise progress schedules to reflect any change in Contract Time, revise sub schedules to adjust times for other items of Work affected by the change, and resubmit.
 - 1. Progress Schedule shall be updated to reflect the changed condition. It shall be identified as a unique single or multiple task activity and shall be linked to its predecessor and successor activities from the base schedule set of activities. An update to the cash flow schedule shall be made as well and to the extent possible, operational tasks shall be cross referenced to schedule of values categories
- C. Promptly enter changes in Project Record Documents.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 29 73**SCHEDULE OF VALUES****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Procedures for preparation and submittal of Schedule of Values.

1.2 RELATED REQUIREMENTS

- A. Section 00 72 13 General Conditions
- B. Section 01 20 13 Application for Payment
- C. Section 01 33 00 Submittals

1.3 FORMAT

- A. Form and content must be acceptable to OWNER.
- B. Contractor's standard form or media-driven printout will be considered on request.
- C. Follow the table of contents of Project Manual and the Bid Schedule for listing component parts. Identify each line item by number and title of listed Specification sections.

1.4 CONTENT

- A. List installed value of each major item of Work and each subcontracted item of Work as a separate line item to serve as a basis for computing values for progress payments. Round off values to nearest dollar.
- B. For each major subcontract, list products and operations of that subcontract as separate line items.
- C. Coordinate listings with progress schedule.
- D. Component listings shall each include a directly proportional amount of Contractor's overhead and profit.
- E. For items on which payments will be requested for stored products, list sub-values for cost of stored products.
- F. No progress payments will be made for Substantial Completion Submittals and Closeout Submittals until all submittals have been submitted to and accepted by OWNER.

- G. The sum of values listed shall equal total Contract Price.

1.5 SUBMITTAL

- A. Submit a copy of Schedule in electronic format within 15 days after the Notice to Proceed. Subsequent updated Schedule of Values shall be presented for review ten days prior to each Application for Payment.
- B. Transmit on an OWNER accepted form transmittal letter. Identify Project by OWNER's title and Project number; identify Contract by OWNER's Contract number.

1.6 SUBSTANTIATING DATA

- A. When OWNER requires substantiating information, submit data justifying line item amounts in question.
- B. Provide an electronic copy of data with cover letter for each copy of the Application for Payment. Show application number and date, and line item by number and description.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 31 19**PROJECT MEETINGS****PART 1 – GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Contractor participation in preconstruction conferences.
- B. Contractor administration of progress meetings and pre-installation conferences.

1.2 PRECONSTRUCTION CONFERENCES.

- A. OWNER will administer a preconstruction conference to be held at VSW's Anchorage office, for execution of Contract and exchange of preliminary submittals. The conference will be scheduled for a mutually agreeable time for the Owner, Engineer, and Contractor following Notice-To-Proceed. During the conference, the contractor shall present his schedule, construction methodology, and other pertinent information. Contractor will be required to field questions about his operation.

1.3 PREINSTALLATION CONFERENCES

- A. When required in individual Specification section, or directed by the Owner, convene a pre-installation conference prior to commencing Work of the section unless this requirement is waived or modified by OWNER.
- B. Require attendance of entities directly affecting, or affected by, Work of the section.
- C. Review conditions of installation, preparation and installation procedures, and coordination with related Work.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 33 00**SUBMITTALS****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Procedures.
- B. Construction Progress Schedules.
- C. Manufacturer's Instructions.
- D. Manufacturer's Certificates.

1.2 RELATED REQUIREMENTS

- A. Section 00 73 13 Supplemental Conditions
- B. Section 01 11 21 Contractor's Certification of Subcontractors
- C. Section 01 20 13 Application for Payment
- A. Section 01 25 13 Product Options and Substitutions
- B. Section 01 26 57 Change Order Procedures
- C. Section 01 29 73 Schedule of Values
- D. Section 01 33 23 Shop Drawings, Product Data, and Samples
- E. Section 01 45 00 Quality Control
- F. Section 01 50 00 Construction Facilities and Temporary Controls
- G. Section 01 71 23 Construction Surveying
- H. Section 01 77 19 Closeout Requirements
- I. Section 01 78 39 Project Record Documents

- J. Division 22 Plumbing
- K. Division 23 Mechanical
- L. Division 26 Electrical
- M. Division 40 Process Integration

1.2 SUBMITTAL PROCEDURES

- A. Delivery of Submittals:
 - a. Within 10 days following Notice to Proceed, Contractor shall submit to OWNER in electronic format, a Submittal Register as required by the Contract (by Section Number, Paragraph Number, Page Number, and time criteria if required). The schedule must be approved by the OWNER before any submittals required by the Contract will be accepted.
 - b. A suggested submittal register is provided in the appendices.
 - c. Deliver submittals directly to the Engineer and copy the OWNER.
 - d. Minimize the number of submittals. Full divisions must be submitted together (no partial submittals will be accepted).
- B. Transmit each item on an Owner accepted form. Identify Project, Contractor, Subcontractor, and major Supplier. Identify pertinent Drawing sheet and detail number, and Specification section number, as appropriate. Identify deviations from Contract Documents by submitting a separate Substitution Request Form. Provide a minimum of 8 1/2" x 5 1/2" blank space on the front page for Contractor, and Engineer review stamps.
- C. Submit initial progress schedules and Schedule of Values in electronic format as directed by the OWNER, in accordance with Document 00 72 13 - General Conditions. Form and content shall be reviewed by Owner. After review by Owner, revise and resubmit as required. Submit subsequent updated schedules with each Application for Payment.
- D. Comply with progress schedule for submittals related to Work progress. Coordinate submittal of related items.
- E. After Engineer review of submittal, revise and resubmit as required, identifying changes made since previous submittal. The Engineer will not return the first or revised copies of rejected submittals for re-use. DO NOT submit partial copies of submittals for incorporation into rejected submittal packages which have been kept by the Engineer. Provide COMPLETE copies for each review.
- F. Distribute copies of reviewed submittals to concerned persons. Instruct recipients to promptly report any inability to comply with provisions.

- G. If drawings, product submittals, samples, mock-ups, or other required submittals are incomplete or not properly submitted, Engineer will not review the submittal and will immediately return submittal to Contractor. Engineer will review a submittal no more than two times (incomplete or improper submittals count as one). Contractor shall pay all review costs associated with more than two reviews, unless a re-submittal is required due to new comments addressing previously submitted information.

1.3 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit horizontal bar Gantt chart. Schedule shall show:
- a. Separate bar for each major trade or operation, identifying the duration of each activity and precedent activities.
 - b. Complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Show each work plan and separate work area as a separate activity or group of activities.
 - c. Submittal dates for Shop Drawings, product data, and samples, and product delivery dates, including any furnished by Owner and those under allowances.
 - d. All required submittals and indicating the date for each required submittal.
 - e. Show projected percentages of completion for each item of Work and submittal as of time of each Application for Progress Payment.
 - f. Schedule shall be computer generated; (MS Projects, Sure-Trac, or Primavera); Gantt format with preceding and succeeding operational tasks indicated by relationship arrows. An accompanying cash flow chart shall reflect estimated monthly draw amounts. To the extent possible, operational tasks shall be cross referenced to schedule of values categories.

1.4 SCHEDULE OF VALUES

- A. Submit in accordance with Section 01 29 73 Schedule of Values.

1.5 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. Submit in accordance with Section 01 33 23 Shop Drawings, Product Data and Samples.
- B. Submit signed and sealed engineering design calculations performed by a Professional Engineer licensed in the State of Alaska where the Contractor is responsible for design as required in the Contract Documents.

1.6 MANUFACTURER'S INSTRUCTIONS

- A. When required in individual Specification Section, submit manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and

finishing, in quantities specified for product data.

1.7 QUALITY CONTROL DATA

- A. Submit in accordance with Section 01 45 00 Quality Control and individual specification sections.

1.8 CONSTRUCTION PHOTOGRAPHS

- A. Provide photographs of construction throughout progress of Work.
- B. Submit photographs via email to the Engineer, Owner and Owner's representatives, not less than daily.
- C. Photographs: Digital color photographs, minimum size 2 megapixels.
- D. Take site photographs from differing directions indicating relative progress of the Work on a daily basis.
- E. Take photographs as evidence of daily project conditions including but not limited to:
 - a. Turbidity alarm and water bypass system upgrades
 - b. Recovered heat system upgrades
 - c. Electrical system upgrades
 - d. Instrumentation upgrades

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 33 23**SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES****PART 1 GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Procedures for submittals.

1.2 RELATED REQUIREMENTS

- A. Section 00 72 13 General Conditions
- B. Section 01 33 00 Submittals
- D. Section 01 45 00 Quality Control
- E. Section 01 25 13 Product Options and Substitutions
- F. Section 01 77 19 Closeout Requirements

1.3 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Label each Shop Drawing with OWNER's Project name and Project number; identify each element of the Shop Drawings by reference to sheet number and detail, or schedule.
- B. Identify field dimensions; show relation to adjacent or critical features or Work or products.
- C. Minimum Sheet Size: 8-1/2"x11". Larger sheets may be submitted in multiples of 8- 1/2"x11".

1.4 PRODUCT DATA

- A. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification section and Article number. Show reference standards, performance characteristics, capacities, wiring and piping diagrams and controls, component parts, finishes, dimensions, and required clearances.
- B. 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.

1.5 SAMPLES

- A. Submit product samples as requested by the Engineer.

- B. Label each sample with identification required for transmittal letter.

1.6 MANUFACTURER'S INSTRUCTIONS

- A. Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, balancing, and finishing under provisions of Section 01 45 00.

1.7 CONTRACTOR REVIEW

- A. 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.
- B. Coordinate submittals with requirements of Work and of Contract Documents.
- C. Notify the Engineer in writing at time of submittal, of any deviations from requirements of Contract Documents.
- D. Do not fabricate products or begin Work which requires submittals until return of submittal with Authority acceptance.

1.8 SUBMITTAL REQUIREMENTS

- A. Each submittal to be numbered by Specification Section and Paragraph. Revisions shall be identified by a hyphen after the paragraph, with a letter designator. Example: 1st submittal "01 33 23 1.08A" 2nd submittal 01 33 23 1.08A - A".
- B. Transmit submittals in accordance with the required submittal schedule and in such sequence to avoid delay in the Work.
- C. Provide 8 1/2" x 5 1/2" blank space on each submittal for Contractor and Engineer stamps.
- D. Apply Contractor's stamp, signed or initialed, certifying to review, verification of products, field dimensions and field construction criteria, and coordination of information with requirements of Work and Contract Documents.
- E. Coordinate submittals into logical groupings to facilitate interrelation of the items.
- F. Submit electronic copies of shop drawings required in the Contract.
- G. Submit electronic copies of product data and manufacturer's instructions required by the contract.
- H. Submit number of samples specified in individual Specifications sections.
- I. Submit under OWNER's accepted transmittal form letter. Identify Project by title and OWNER's Project number; identify Contract by OWNER's contract number. Identify Work and product by Specification section and Article number.
- J. Each submittal shall have as its face document a completed, Authority furnished,

Submittal Summary form.

1.9 RESUBMITTALS

- A. After the Engineer review of submittal, revise and resubmit as required, identifying changes made since previous submittal. Engineer will not return the first or revised copies of rejected submittals for re-use. DO NOT submit partial copies of submittals for incorporation into rejected submittal packages which have been kept by the Engineer. Provide COMPLETE copies for each review.

1.10 REVIEW

- A. OWNER or authorized agent will review Shop Drawings, product data, and samples and return submittals within (14) working days.
- B. OWNER or authorized agent will examine shop drawings for general arrangement, overall dimensions and suitability, and will return to the Contractor marked as follows:

"Submit Specified Item" - denotes that the item specified in the contract documents is required and substitutions are not acceptable.

"Approved" - denotes acceptance of the submittal.

"Approved With Corrections Noted" - denotes review is conditional on compliance with notes made on the submittal.

"Revise and Resubmit" - denotes that revisions are required in the submittal in order for the submittal to be generally consistent with the requirements of the Contract Documents. Required revisions will be identified to the Contractor. Resubmittal is required.

"Rejected" - denotes that the submittal does not meet the requirements of the Contract Documents and shall not be used in the Work. Reasons for rejection will be identified to the Contractor. Resubmittal is required.

- C. Review by OWNER or authorized agent of shop drawings shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is consistent with the requirements of the Contract Documents. Review of such drawings shall not relieve the Contractor of the responsibility for errors, dimensions, and detail design.
- D. OWNER or authorized agent review will not extend to means, methods, techniques, sequences or procedures of construction (except in the case of construction specific submittals, such as erection plans) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in with the item functions.

1.11 DISTRIBUTION

- A. Duplicate and distribute reproductions of Shop Drawings, copies of product data, and samples, which bear Engineer's stamp, to job site file, record documents file,

Subcontractors, Suppliers, and other entities requiring information.

1.12 SCHEDULE OF SUBMITTALS

- A. Submittal Register Form to be completed by Contractor and approved by OWNER prior to submittal of any items.
- B. Submit shop drawings, product data and samples as required for each specification section.
- C. Format.
 - 1. Submittal schedule form as provided by OWNER as outlined in Section 01 45 00 1.7.

Part 2 – PRODUCTS

Not Used

Part 3 – EXECUTION

Not used

END OF SECTION

SECTION 01 42 19**REFERENCE STANDARDS****PART 1 – GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Quality assurance.

1.2 RELATED REQUIREMENTS

- A. Section 00 72 13 General Conditions

1.3 QUALITY ASSURANCE

- A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date for receiving bids, unless otherwise stated in the Contract Documents.
- C. Obtain copies of standards when required by the Contract Documents.
- D. Maintain copy at Project Site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from the Engineer before proceeding. Local code requirements, where more stringent than referenced standards, shall govern.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 45 00**QUALITY CONTROL****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Quality Control Program Requirements
- B. Workmanship.
- C. Manufacturer's Instructions.
- D. Manufacturer's Certificates.
- E. Manufacturers' Field Services

1.2 RELATED REQUIREMENTS

- A. Section 00 72 13 General Conditions: Article 12, inspection and testing required by governing authorities.
- B. Section 01 33 00 Submittals: Submittal of Manufacturer's Instructions.

1.3 DESCRIPTION

- A. The Contractor shall assure that all materials and completed construction conform to contract Plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. When required, the Contractor shall establish, provide, and maintain an effective Quality Control Program that details the methods and procedures that will be used. Although guidelines are established and certain minimum requirements are specified herein and elsewhere in the contract technical specifications, the Contractor shall assume full responsibility for accomplishing the stated purpose.
- B. The intent of this section is to enable the Contractor to establish a necessary level of control that will:
 - 1. Adequately provide for the production of acceptable quality materials.
 - 2. Provide sufficient information to assure both the Contractor and the Engineer that the specification requirements can be met.
 - 3. Allow the Contractor as much latitude as possible to develop his own standard of control.

- C. The Contractor shall be prepared to discuss and present, at the preconstruction conference, his understanding of the quality control requirements. The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the Quality Control Program has been reviewed by the Engineer. No partial payment will be made for materials subject to specific quality control requirements until the Quality Control Program has been reviewed.
- D. The quality control requirements contained in this section and elsewhere in the contract technical specifications are in addition to and separate from the acceptance testing requirements. Acceptance testing requirements are the responsibility of the Engineer.

1.4 DESCRIPTION OF PROGRAM

A. General Description

The Contractor shall establish a Quality Control Program to perform inspection and testing of each item of work for which it is required by the technical specifications, including those performed by subcontractors. This Quality Control Program shall ensure conformance to applicable parts of the contract documents (plans and specifications) with respect to materials, workmanship, construction, finish, and functional performance. The Quality Control Program shall be effective for control of all construction work performed under this Contract and shall specifically include (1) surveillance and tests required by the technical specifications, (2) other requirements of this section, and (3) any other activities deemed necessary by the Contractor to establish an effective level of quality control.

B. Quality Control Program.

The Contractor shall describe the Quality Control Program in a written document which shall be reviewed by the Engineer prior to the start of any production, construction, or off-site fabrication. The written Quality Control Program shall be submitted to the Engineer for review at least 5 calendar days before the preconstruction conference.

C. The Quality Control Program shall be organized to address, as a minimum, the following items:

1. Quality control organization;
2. Project progress schedule;
3. Submittals schedule;
4. Inspection requirements;

5. Quality control testing plan;
 6. Documentation of quality control activities; and
 7. Requirements for corrective action when quality control and/or acceptance criteria are not met.
- D. The Contractor is encouraged to add any additional elements to the Quality Control Program that he/she deems necessary to adequately control all production and/or construction processes required by this contract.

1.5 QUALITY CONTROL AND ORGANIZATION

- A. The Contractor's Quality Control Program shall be implemented by the establishment of a separate quality control organization. An organizational chart shall be developed to show all quality control personnel and how these personnel integrate with other management/production and construction functions and personnel.
- B. The organizational chart shall identify all quality control staff by name and function, and shall indicate the total staff required to implement all elements of the Quality Control Program, including inspection and testing for each item of work. If necessary, different technicians can be utilized for specific inspection and testing functions for different items of work. If an outside organization or independent testing laboratory is used for implementation of all or part of the Quality Control Program, the personnel assigned shall be subject to the qualification requirements of this specification. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.
- C. The quality control organization shall consist of the following minimum personnel:
1. Program Administrator. The Program Administrator shall be a full-time employee of the Contractor, or a consultant engaged by the Contractor. The Program Administrator shall have a minimum of 10 years of experience in bulk fuel facility construction and shall have had prior quality control experience on a project of comparable size and scope as the contract.

The Program Administrator shall have full authority to institute any and all actions necessary for the successful implementation of the Quality Control Program to ensure compliance with the contract documents. The Program Administrator shall report directly to a responsible officer of the construction firm. The Program Administrator may supervise the Quality Control Program on more than one project provided that person can be at the job site within 12 hours after being notified of a problem.

2. Quality Control Technicians. A sufficient number of quality control technicians necessary to adequately implement the Quality Control

Program shall be provided. These personnel shall be either engineers, engineering technicians with five (5) years of experience, or experienced craftsman with qualifications in the appropriate field with a minimum of two (2) years of experience in their area of expertise and National Institute for Certification in Engineering Technologies (NICET) certification.

The quality control technicians shall report directly to the Program Administrator and shall perform the following functions:

- a. Inspection of all materials, construction, plant, and equipment for conformance to the technical specifications, and as required by the contract documents.
- b. Performance of all quality control tests as required by the technical specifications.

Engineer approval or certification at an equivalent level by a state or nationally recognized organization will be acceptable in lieu of NICET certification.

2. Staffing Levels. The Contractor shall provide sufficient qualified quality control personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the work, separate plant and field technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match the type and pace of work activity. The Quality Control Program shall state where different technicians will be required for different work elements.

1.6 WORKMANSHIP AND STANDARDS

- A. The Contractor's quality control program shall ensure compliance with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. The Contractor shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking
- C. Contractor shall comply with manufacturer's instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from the Engineer before proceeding.
- D. When required by individual Specifications section, submit manufacturer's certificate, in duplicate, that products meet or exceed specified requirements.

1.7 SUBMITTALS SCHEDULE

- A. The Contractor shall submit a detailed listing of all submittals and shop drawings required by the technical specifications. The listing can be developed in a spreadsheet format and shall include:

1. Specification item number;
2. Item description;
3. Description of submittal;
4. Specification Subsection requiring submittal; and
5. Scheduled date of submittal.

1.8 INSPECTION REQUIREMENTS

- A. Quality control inspection functions shall be organized to provide inspections for all definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified by this specification.
- B. Inspections shall be performed daily to ensure continuing compliance with contract requirements until completion of the particular feature of work. These shall include the following minimum requirements:
 1. During fabrication of contractor provided, shop fabricated equipment and/or structures, plant operation for material production, quality control test results and periodic inspections shall be utilized to ensure the quality of the materials and workmanship. The Quality Control Program shall detail how these and other quality control functions will be accomplished and utilized to ensure compliance with A applicable codes and standards.
 2. During field operations, quality control test results and periodic inspections shall be utilized to ensure the quality of all materials and workmanship. All equipment shall be inspected to ensure its proper operating condition and to ensure that all such operations are in conformance to the technical specifications and are within the plan dimensions, lines, grades, and tolerances specified. The Program shall document how these and other quality control functions will be accomplished and utilized.

1.9 QUALITY CONTROL TESTING PLAN

- A. As a part of the overall Quality Control Program, the Contractor shall implement a quality control testing plan, as required by the technical specifications. The testing plan shall include the minimum tests and test frequencies required by the technical specification Item, as well as any additional quality control tests that the Contractor deems necessary to adequately control production and/or construction processes.
- B. The testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

1. Specification item number;
 2. Item description (e.g., Schedule 80 pipe);
 3. Test type (e.g., NDT, pipe pressure test);
 4. Test standard (e.g., ASTM or NACE test number, as applicable);
 5. Test frequency (e.g., as required by technical specifications or minimum frequency p);
 6. Responsibility (e.g., plant or field technician); and
 7. Control requirements (e.g., target, permissible deviations).
- C. The Engineer shall be provided the opportunity to witness quality control sampling and testing.
- D. All quality control test results shall be documented by the Contractor as required by this specification and submitted to the Engineer for approval.

1.10 MANUFACTURERS' FIELD SERVICES

- A. When required by manufacturer or when specified in respective Specification sections, require manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to make appropriate recommendations.
- B. Require manufacturer's representative to submit written report to the Engineer listing observations and recommendations.

1.11 DOCUMENTATION

- A. The Contractor shall maintain current quality control records of all inspections and tests performed. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken.
- B. These records must cover both conforming and defective or deficient features, and must include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies of these records shall be furnished to the Engineer daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the Contractor's Program Administrator.

- C. Specific Contractor quality control records required for the contract shall include, but are not necessarily limited to, the following records:
1. Daily Inspection Reports. Each Contractor quality control technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations on a form acceptable to the Engineer. These technician's daily reports shall provide factual evidence that continuous quality control inspections have been performed and shall, as a minimum, include the following:
 - a. Technical specification item number and description;
 - b. Compliance with approved submittals;
 - c. Proper storage of materials and equipment;
 - d. Proper operation of all equipment;
 - e. Adherence to contract documents;
 - f. Review of quality control tests; and
 - g. Safety inspection.

The daily inspection reports shall identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

The daily inspection reports shall be signed by the responsible quality control technician and the Program Administrator. The Engineer shall be provided at least one copy of each daily inspection report on the work day following the day of record.
 2. Daily Test Reports. The Contractor shall be responsible for establishing a system which will record all quality control test results. Daily test reports shall document the following information:
 - a. Technical specification item number and description;
 - b. Test designation;
 - c. Location;
 - d. Date of test;
 - e. Control requirements;
 - f. Test results;
 - g. Causes for rejection;

- h. Recommended remedial actions; and
- i. Retests.

Test results from each day's work period shall be submitted to the Engineer prior to the start of the next day's work period. When required by the technical specifications, the Contractor shall maintain statistical quality control charts. The daily test reports shall be signed by the responsible quality control technician and the Program Administrator.

1.12 CORRECTIVE ACTION REQUIREMENTS

- A. The Quality Control Program shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process into control. The requirements for corrective action shall include both general requirements for operation of the Quality Control Program as a whole, and for individual items of work contained in the technical specifications.
- B. The Quality Control Program shall detail how the results of quality control inspections and tests will be used for determining the need for corrective action and shall contain clear sets of rules to gauge when a process is out of control and the type of correction to be taken to regain process control.
- C. When applicable or required by the technical specifications, the Contractor shall establish and utilize statistical quality control charts for individual quality control tests. The requirements for corrective action shall be linked to the control charts.

1.13 INSPECTION BY THE ENGINEER

- A. All items of material and equipment shall be subject to inspection by the Engineer at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate quality control system in conformance with the requirements detailed herein and the applicable technical specifications and plans. In addition, all items of materials, equipment and work in place shall be subject to inspection by the Engineer at the site for the same purpose.
- B. Inspection by the Engineer does not relieve the Contractor of performing quality control inspections of either on-site or off-site Contractor's or subcontractor's work.

1.14 NONCOMPLIANCE

- A. The Engineer will notify the Contractor of any noncompliance with any of the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Any notice, when delivered by the Engineer or their authorized representative to the Contractor or their

authorized representative at the site of the work, shall be considered sufficient notice.

- B. In cases where quality control activities do not comply with either the Contractor's Quality Control Program or the contract provisions, or where the Contractor fails to properly operate and maintain an effective Quality Control Program, as determined by the Engineer, the Engineer may:
1. Require the Contractor to replace ineffective or unqualified quality control personnel or subcontractors.
 2. Require the Contractor to stop operations until appropriate corrective action is taken.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 50 00**CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Temporary Utilities: water, sanitation, electrical, heating and communication systems.
- B. Temporary Construction Facilities: Field office for the use of Contractor personnel, storage yards and buildings, worker shelters and access roads.
- C. Temporary Controls: air/water pollution controls, erosion control and traffic control.
- D. Temporary Fuel Storage and Dispensing: fuel storage, secondary containment and dispensing facilities.

1.2 RELATED REQUIREMENTS

- A. Section 01 11 13 Work Covered by Contract Documents
- B. Section 01 33 00 Submittals
- C. Section 01 57 13 Temporary Erosion & Sediment Control

1.3 DELIVERY, STORAGE AND HANDLING OF TEMPORARY FACILITIES

- A. Protect temporary facilities during delivery and storage operations.
- B. Maintain temporary facilities in proper and safe condition throughout progress of the work.

1.4 SUBMITTALS

- A. Submit an electronic copy of written Plan for providing temporary facilities. Submit plan a minimum of 60 days from receipt of the "Intent to Award letter".
 - 1. Plan shall include written description of Contractor's proposed methods and means of providing temporary utilities during construction activities, as described in the Specifications.

PART 2 - PRODUCTS**2.1 TEMPORARY UTILITIES CONTRACTOR FURNISHED ITEMS**

- A. Temporary Sanitation Systems

1. Furnish and install all necessary components and systems to provide sewer and solid waste collection services at the field office. Temporary outhouses shall be self contained units, pit privies are not acceptable.
 2. Contractor furnished items include, but are not limited to, all piping, valves, fittings, structures, insulation, pumps, tanks, fixtures, tie-ins, trash receptacles, hauling operations and service agreements.
 3. Contractor to provide and pay for all temporary sanitation system related components and fees.
- B. Temporary Electrical Systems
1. Coordinate with local utility to provide all electrical service necessary for completion of the work. Provide minimum 30 days notice to local utility for hookup. Coordinate necessary utility paperwork for hookup.
 2. Contractor furnished items include, but are not limited to, all conductor, transformers, service meters and masts, distribution panels, controls, electrical and lighting fixtures, tie-ins, and service agreements.
 3. Contractor shall be responsible for providing temporary power to all electrical control panels to ensure that they remain heated from the time of installation to substantial completion.
 4. Contractor to provide and pay for all temporary electrical system related components and fees including hookup.
- C. Temporary Heating Systems
1. Furnish and install all necessary components and systems to provide heat at the field office and worker shelters as required.
 2. Contractor furnished items include, but are not limited to, all heaters, fuel tanks, piping, valves, fittings, meters, insulation, pumps, fixtures, tie-ins, and fuel hauling.
 3. Contractor to provide and pay for all temporary heating system related components and fees.
- D. Temporary Communication Systems (Telephone, Fax, and Internet)
1. Furnish and install all necessary components and systems to provide telephone, fax and internet service to the field office.
 2. Contractor furnished items include, but are not limited to, all phone lines, phones, fax machines, tie-ins, and service agreements.
 3. Contractor to provide and pay for all temporary communication system related components and fees.

2.2 TEMPORARY CONSTRUCTION FACILITIES CONTRACTOR FURNISHED ITEMS

- A. Temporary Construction Facilities (Field Office, Storage Facilities, Worker Shelters)
1. Temporary field office: Furnish field office building for use of Contractor personnel. Field office structure shall meet all requirements of the most current version of the IBC. Provide temporary electrical, heating, telephone, fax and internet services at the field office.
 2. Temporary storage facilities: Furnish temporary storage facilities as required to protect materials and equipment during the course of the work. Facilities shall be structurally sound and sufficiently weather tight to protect stored items in accordance with the manufacturer's recommendations.
 3. Worker shelters: Worker shelters shall be provided in accordance with applicable laws and regulations.
 4. Contractor to provide and pay for all temporary construction facility related components and fees.

2.3 TEMPORARY CONTROLS CONTRACTOR FURNISHED ITEMS

- A. Temporary Controls
1. Furnish all gates, barricades, fences, handrails, guardrails, and security systems required for safe execution and protection of the work.
 2. Furnish all Guards, markers, shields, protective clothing, hard hats, hearing protection and other equipment required by health and safety regulations for workers.
 3. Furnish all required first aid and fire suppression equipment required by laws and regulations.
 4. Contractor to provide and pay for all temporary controls related components and fees.

PART 3 – EXECUTION

3.1 TEMPORARY UTILITIES

- A. All work relating to temporary utilities shall be arranged and implemented by the Contractor.
- B. All costs associated with providing temporary utilities shall be borne solely by the Contractor including hookup.
- C. Contractor shall not connect to any existing utility system unless specific written authorization from the applicable utility company is given.
1. Contractor shall provide individuals who are qualified to connect to

- the existing utility system and provide all necessary equipment and materials required for the connection.
2. Contractor shall at no time exceed the usage allowed by the governing utility.
 3. Contractor shall remove all temporary materials and equipment upon completion of construction and repair any damage caused by installation, and restore to like new condition.
- D. Water: Provide temporary water for all construction requirements and Contractor's crews. Contractor shall maintain sanitary conditions at all times and shall not violate requirements of applicable codes.
- E. Sanitation Facilities: Provide and maintain facilities for Contractor's employees, Subcontractors and all other onsite employer's employees. Service, clean, and maintain facilities and enclosures.
- F. Electricity and Lighting: Provide temporary power for all construction requirements including Contractor's field office and to ensure safe work conditions and security of site. Provide temporary lighting as required to meet all applicable safety requirements to allow erection, application or installation of materials and equipment, and observation or inspection of the work.
- G. Heating: Provide temporary heating systems at the field office and other temporary construction facilities as required by laws and regulations.
- H. Communication Systems: Provide temporary communication systems at the field office including telephone, fax, and internet service.

3.2 TEMPORARY CONSTRUCTION FACILITIES

- A. Field Office: Contractor shall maintain an on-site field office.
1. Field office shall provide sufficient working space and sanitary facilities for Contractor personnel. Provide temporary electrical, heating, water, sewer, telephone, fax and internet services at the field office.
- B. Temporary Storage Yard:
1. Temporary storage yard shall be constructed for storage of products that are not subject to damage by weather conditions.
- C. Temporary Storage Buildings:
1. Environmental control systems shall be provided that meet recommendations of manufacturers of equipment and materials stored.
 2. Contractor shall arrange or partition to provide security of contents and ready access for inspection and inventory.
 3. Combustible materials (paints, solvents, fuels, etc.) shall be stored in a

well- ventilated and remote building meeting applicable safety standards.

- D. Access roads:
 - 1. Access roads, if required, shall be constructed within easements, rights-of- way, or Project limits. Alignments for new routes shall be approved by Engineer.
 - 2. Ground surface disturbed by access road construction shall be restored to original grade upon completion of construction.

3.3 TEMPORARY CONTROLS

- A. Air Pollution Controls:
 - 1. Minimize air pollution from construction operations.
 - 2. Burning of waste materials, rubbish, or other debris will not be permitted on or adjacent to the site.
- B. Water Pollution Controls:
 - 1. Contractor shall not cause or permit action to occur which would cause a discharge to an existing waterway. See Section 01 57 13.
- C. Erosion Control:
 - 1. As specified in Section 01 57 13.

3.4 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain work areas free of waste materials, debris, and rubbish. Maintain work site in a clean, orderly and organized condition. Materials should be clearly identified, with products covered and labeled. Materials should be identified with generator (Contractor) name.
- B. Collect and remove waste materials, debris, and rubbish from site periodically and dispose of in accordance with all Federal, State and local regulations.
- C. Contractor shall not dispose of hazardous materials such as mineral spirits, oil, chemicals, or paint thinner at the local land fill. Provide acceptable containers for collection and disposal of waste materials, debris and rubbish.

3.5 REMOVAL OF TEMPORARY FACILITIES

- A. Remove temporary materials, equipment, services, and construction prior to Substantial Completion inspection, with the exception of temporary bulk fuel storage.
- B. Clean and repair damage caused by installation or use of temporary

facilities. Restore permanent facilities used during construction to pre-construction condition.

END OF SECTION

SECTION 01 60 13**MATERIAL AND EQUIPMENT****PART 1 - GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Products.
- B. Transportation and Handling.
- C. Storage and Protection.

1.2 RELATED REQUIREMENTS

- A. Section 01 45 00 Quality Control: Submittal of manufacturers' certificates.

1.3 PRODUCTS

- A. Products include material, equipment, and systems.
- B. Comply with Specifications and referenced standards as minimum requirements.
- C. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.
- D. Do not use materials and equipment removed from existing structure, except as specifically required, or allowed, by Contract Documents.

1.4 TRANSPORTATION AND HANDLING

- A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry.
- B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.
- C. Immediately on delivery, inspect shipment to assure:
 - 1. Product complies with requirements of Contract Documents and reviewed submittals.
 - 2. Quantities are correct.
 - 3. Accessories and installation hardware are correct.
 - 4. Containers and packages are intact and labels legible.
 - 5. Products are protected and undamaged.

1.5 STORAGE AND PROTECTION

- A. Handle and store materials for construction, products of demolition, and other items to avoid damage to adjacent facilities and equipment.
- B. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.
- C. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter. Cover such material to prevent material from being blown away.
- D. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.
- E. Provide Material Safety Data Sheets (MSDS) for all products which may produce unpleasant or noxious odors. Contractor shall provide for adequate venting if needed.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

PART 4 - BASIS OF MEASUREMENT AND PAYMENT

4.1 BASIS OF MEASUREMENT

- A. There is no measurement for this item.

END OF SECTION

SECTION 01 71 23
CONSTRUCTION SURVEYING

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. This section is intended to establish a standard minimum level of acceptable field survey specifications and procedures to properly control the construction project.
- B. The Contractor shall furnish all labor and materials necessary to perform all surveying and construction staking essential for the completion of construction in conformance with the drawings, specifications, and other Contract Documents. The Contractor shall perform all the necessary calculations required to accomplish the work.
- C. It is the Contractor's responsibility to ensure proper survey methods and procedures are followed. The Contractor, at no additional expense to the Owner, shall correct any errors resulting from the survey. Any method conflicting with these survey specifications shall be approved by the Engineer prior to its use.
- D. All survey work performed shall be under the direct supervision of a Professional Land Surveyor registered in the State of Alaska.

1.2 RELATED SECTIONS

- A. Section 01 78 39 Project Record Documents

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 PROJECT CONTROL

- A. General: It is the Contractor's responsibility to establish and check all survey control prior to any staking activity to ensure that the Project is properly located and constructed according to the Contract Documents. If discrepancies are found, Engineer shall be notified separately and immediately. The Contractor is responsible for preserving and protecting all line stakes, grade stakes, reference points, and hubs. In the event of their loss or destruction the Contractor shall pay all costs for their replacement. The Contractor shall replace any monument that exists within the construction limits if it is disturbed or removed due to construction project activity. All monumentation disturbed or removed shall be replaced with the same type of monument or a monument approved by the Engineer.
- B. Horizontal Control Accuracy: The maximum permissible linear error allowed in establishing horizontal control is 1:5000 feet. The maximum error

allowed in unadjusted angular closure shall be calculated by the formula "30 multiplied by

the square root of N" where the term "N" signifies the number of transit setups in the traverse and "30" signifies 30 seconds.

C. Vertical Control

1. Elevations shall originate from the datum provided in the Contract Drawings. All level circuits run to establish temporary benchmarks (TBM) shall have an accuracy no less than the value computed by the equation "0.1 feet multiplied by the square root of the distance in miles." Foresights and backsights shall be balanced. The maximum sighting distance shall not exceed 300 feet. All leveling circuits establishing TBMs shall be adjusted using recognized standard surveying adjustment methods. Side shots to establish elevations on TBMs shall not be allowed.
2. A minimum of two known benchmarks shall be used when establishing TBMs to verify correct elevation information. A sufficient number of TBMs shall be set to control the Project with a maximum spacing of 800 feet. A TBM shall not be located further than 200 feet outside the construction limits of the Project. All TBMs shall be located and be comprised of sufficient material such that their integrity will not be compromised throughout the life of the Project.

3.2 FIELD NOTES

- A. The Contractor shall supply uniform, hard backed, write in rain survey field books. The Engineer has the right to inspect the field books at any time during the Project. All field books shall be identified on the outside spine. Each book shall be indexed and its contents referred to by page number. The date, weather condition, survey crew personnel, and instruments used shall be shown at the beginning of each day's notes. All field books containing field notes shall be sealed and signed by a Registered Professional Land Surveyor on the title page of each field book. Copies of all field books used in the process of work shall be submitted to the Engineer upon completion of the work.
- B. All observations shall be recorded directly into project field books. All field books shall be in pencil. All field notes and drawings shall be completed and reduced before acceptance by the Engineer. Control sketches and traverse data shall be graphic and show measured and recorded distances. The source of record shall be stated. Stationing shall increase from the bottom of the page to the top. Notes shall be neat, legible, precise and sufficiently detailed. The Engineer may stop all survey work until the notes are brought into conformance with this specification. A copy of each day's field notes shall be reduced and available to the Engineer by 12:00 PM the following workday. The Engineer may issue a stop work order at the Contractor's expense if the field notes are not delivered, when requested, within this time frame.

- C. Erasures of errors in field books will not be accepted. A line shall be drawn through those portions of notes in error, leaving the original note legible, and the correction shall be noted above the original entry. Corrections shall be initialed by the party chief and dated. Where appropriate, a note explaining the error shall be included.
- D. Failure on the part of the Contractor to keep and maintain complete and accurate field notes as required herein shall be sufficient reason to withhold payment for those items of work where survey is required. No final Project payment will be made to the Contractor until copies of the field books have been submitted to and approved by the Engineer.

3.3 PARTY CHIEF'S DAILY DIARY

- A. The survey party chief shall keep a factual daily diary of all work performed by the survey crew on this Project. The diary shall contain the following information: date, crew, type and location of work performed, work accomplished, orders from the Engineer and signature.
- B. This record shall be kept on the Project Site and submitted to the Engineer upon request. A copy of the diary shall be submitted to the OWNER upon completion of the Project.

3.4 MISCELLANEOUS CONSTRUCTION STAKING

- A. The Contractor shall provide sufficient stakes for the adequate control of all structures and incidental construction not specifically covered above. A staking diagram with respect to fuel line stations and measurements for pay quantities shall be maintained in the field notes. Other items such as horizontal and vertical control shall be shown in the field book and shall be governed by procedures established in previous articles of this specification.

3.5 ELECTRONIC DATA COLLECTION AND RADIAL SURVEYS

- B. When electronic data collection is used for radial stakeout, the following criteria shall be maintained and submitted:
 - 1. A standard field book containing: date, weather conditions, instrumentation used, crew, project description and sketch, listing of turning points and control points used, and other information needed to reconstruct the survey activity.
 - 2. A printout of the unedited output from the data collector or a copy of the field book entries to include: code descriptors, horizontal circle information, vertical circle information based on zenith angle and slope distance expressed in feet. Also, a sheet containing the explanation of the codes used to identify the various shots.
 - 3. A printout of the reduced and adjusted (ratios of error and magnitude of misclosure shown) data represented by x, y, and z coordinates, plus necessary descriptive information.
 - 4. A plot and or line drawing showing the control points, point occupied, and the radial observations at a scale large enough to read the point

number, elevation, point descriptions, and coordinates.

5. If cross sectional data is collected by radial methods a printout/plot of the following data is required:
 - a. Each point identified as it relates to the fuel line centerline station.
 - b. The distance offset from centerline of the fuel line.
 - c. The elevation and description of the shot.
 - d. A cross section line plot of each station with the individual shots averaged out to produce the final interpolated cross section.
 - e. The vertical angle and distance to the TBM's used for control and the instrument height, and the height of the prisms.

3.6 AS-BUILT SURVEYS, FIELD NOTES AND PROJECT RECORD DOCUMENTS

- A. As-built survey measurements shall be recorded on a clean set of design drawings deemed the Project Record Documents and shall show changes and improvements which vary from the dimensions, lines, grades, locations and materials as shown on the Contract Drawings. The as-builts shall also include swing ties to all pertinent existing structures, in accordance with Section 01 78 39.
- B. Survey measurements shall be taken, field notes shall be kept, and accuracies shall be attained in accordance with the specifications of this section.
- C. When electronic data collection is used to obtain as-built information, the following information shall be maintained and submitted:
 1. A printout of the unedited, raw data from the data collector
 2. An explanation of all codes and abbreviations used
 3. A printout of the x, y, and z coordinates
 4. An electronic file, suitable for insertion into AutoCAD, with as-built features indicated by horizontal position, description, and elevation, based on Project coordinates.

Electronic data collection used to obtain as-built information does not relieve the Contractor's obligation to maintain Project Record Documents or the obligation to obtain swing ties.

- D. A copy of all survey field notes shall be submitted with each pay request. Pay requests shall not be processed until the survey notes are received by the Engineer and the Engineer is provided evidence that the Project Record Documents are current and in the required condition.
- E. Project Record Documents shall be redlined and kept current. They shall be kept ready for review for when the Engineer, at his/her option, requests that the Project Record Documents be submitted with the survey field notes for the pay request.
- F. Project Record Documents shall be submitted along with a copy of the field notes to the Engineer at the completion of construction activity, in

accordance with Section 01720 Project Record Documents, of these Specifications.

PART 4 - BASIS OF MEASUREMENT AND PAYMENT

4.1 BASIS OF MEASUREMENT

- A. There is no measurement for this item.

4.2 BASIS OF PAYMENT

- A. All costs associated with these items shall be subsidiary to Civil Site Work bid items.

END OF SECTION

SECTION 01 77 19
CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Administrative provisions for Substantial Completion and for Final Acceptance.
- B. Closeout Procedures.
- C. Final Cleaning.
- D. Project Record Documents.
- E. Warranties and Bonds.
- F. Spare Parts and Maintenance Materials.

1.2 RELATED REQUIREMENTS

- A. Document 00 72 13 General Conditions: Fiscal provisions, and additional administrative requirements.
- B. Section 01 33 00 Submittals
- C. Section 01 29 73 Schedule of Values
- D. Section 01 78 39 Project Record Documents

1.3 FINAL CLEANING

- A. Execute final cleaning prior to Substantial Completion inspection.
- B. Use materials which will not create hazards to health or property, and which will not damage surfaces. Follow manufacturer's recommendations.
- C. Remove waste, debris and surplus materials from the site.

1.4 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

1.5 PROJECT RECORD DOCUMENTS

- A. Comply fully with the requirements of Section 01 78 39 Project Record Documents.

1.6 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual Specification Sections.
- B. Deliver to Project site and place in location as directed, obtain receipt prior to final payment.

1.7 WARRANTIES

- A. As specified in Section 00 72 13 – General Conditions Article 12.7, Contractor shall warranty all work for a period of 1 year after substantial completion, unless longer warranty periods are specified for individual products or pieces of work.
- B. As a condition precedent to Final Payment, all guaranties and warranties as specified under various sections of the Contract Documents shall be obtained by the Contractor and delivered to the Owner, in duplicate giving a summary of guarantees attached and stating the following in respect to each:
 - 1. Character of Work affected.
 - 2. Name of Subcontractors.
 - 3. Period of Guarantee.
 - 4. Conditions of Guarantee.
- C. Delivery of said guarantees and/or warranties shall not relieve the Contractor from any obligations assumed under any other provision of the Contract.
- D. If, within any guarantee period, repairs or changes are required in connection with the guaranteed Work, which in the opinion of Owner is rendered necessary as the result of the use of materials, equipment or workmanship, which are defective, or inferior, or not in accordance with the terms of the Contract, the Contractor shall, upon receipt of notice from the Owner, and without expense to Owner, proceed within seven (7) calendar days to:
 - 1. Place in satisfactory conditions in every particular all of such guaranteed Work, correct all defects therein, and make good all damages to the structure or site.
 - 2. Make good all Work or materials, or the equipment and contents of structures or site disturbed in fulfilling any such guarantee.
- E. If the Contractor, after notice, fails to comply with the terms of the guarantee, OWNER may have the defects corrected and the Contractor and Contractor's Surety shall be liable for all expenses incurred in connection therewith, including

Engineer's fees.

1.8 OPERATIONS AND MAINTENANCE DATA (O&M MANUALS)

- A. Submit an electronic copy of draft O&M manuals ten (10) working days prior to Substantial Completion inspection. Revise and resubmit as necessary based on engineer mark-ups.
- B. The Engineer shall approve the draft O&M manuals for use in on-site facility training prior to completion of a Substantial Completion inspection.
- C. Submit four (4) sets of final O&M manuals within 15 days of Substantial Completion inspection or date of approval of draft operations and maintenance manuals.
- D. Submit data in bound 8-1/2 x 11 inch text pages, ring binders with durable plastic covers.
- E. Prepare binder cover with printed title "OPERATIONS AND MAINTENANCE DATA", title of project, and subject matter of binder.
- F. Binder contents shall be divided with plastic page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- G. Contents: Prepare a table of contents for each volume, with each Product or system description identified, enclosed in a plastic text sheet sleeve, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses and telephone numbers of A/E, Contractor, subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system process flow and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and Product data.
 - b. Pressure test reports.
 - c. Certificates.
 - d. Copies of Warranties and Bonds.

1.9 ON-SITE FACILITY TRAINING

- A. Contractor shall conduct on-site training of the operation of the new facilities for the facility owners and/or operators. Training must be completed prior to substantial completion inspection. Notify the Owner fifteen (15) working days prior to training date.
- B. Facility Training shall include:
 - 1. A thorough walk through of the facility and operational components.
 - 2. Presentation of the O&M Manuals including
 - i. Discussion of where the O&M Manuals will be kept
 - ii. Discussion of required facility maintenance
 - iii. Discussion of the product components
 - iv. Discussion of the operational procedures and troubleshooting alarms
- C. Each attendee shall demonstrate competency at operating new facilities.
- D. Training shall be approximately two (2) four (4) hour sessions. Total training duration shall be a minimum of eight hours.

1.10 SUBSTANTIAL COMPLETION SUBMITTALS

Submit the following prior to requesting a Substantial Completion Inspection:

- A. Project Record Documents: Under provisions of Section 01 78 39.
- B. Operation and Maintenance Data (O&M Manual): Under provisions of Section 01 77 19.
- C. Spare Parts and Maintenance Materials: Under provisions of Section 01 77 19.

1.11 SUBSTANTIAL COMPLETION

- A. Substantial Completion shall be considered by OWNER when:
 - 1. Written notice is provided seven (7) days in advance of inspection date.
 - 2. List of items to be completed or corrected is submitted.
 - 3. Equipment and systems have been tested, adjusted, balanced and are fully operational.
 - 4. Operation of system has been demonstrated to the Owner.

5. Certificates of Inspection for required inspections have been submitted.
 6. Project Record Documents for the Work or the portion of the Work being accepted are submitted and approved.
 7. Spare parts and maintenance materials are turned over to OWNER.
- B. Should OWNER's inspection find that the Work is not substantially complete, Owner will promptly notify Contractor in writing, listing observed deficiencies.
- C. Contractor shall remedy deficiencies and send a second written notice of Substantial Completion.
- D. When OWNER finds that the Work is substantially complete the Owner will prepare a certificate of Substantial Completion in accordance with provisions of General Conditions.

1.12 FINAL COMPLETION

- A. When Contractor considers Work is complete, submit written certification:
1. Contract Documents have been reviewed.
 2. Work has been inspected for compliance with Contract Documents.
 3. Work has been completed in accordance with Contract Documents, and deficiencies listed with certificate of Substantial Completion have been corrected.
 4. Work is complete and ready for final inspection.
- B. Should OWNER's inspection find the Work incomplete, the Owner will promptly notify Contractor in writing listing observed deficiencies.
- C. Contractor shall remedy deficiencies and send a second certification of Final Completion.
- D. When OWNER finds that the Work is complete, the Owner will consider closeout submittals.

1.13 REINSPECTION FEES

- A. Should status of completion of Work require more than one re-inspection by OWNER OR ENGINEER due to failure of Work to comply with Contractor's responsibility, OWNER will deduct the cost of re-inspection from final payment to Contractor as provided in the Contract Documents.
- B. Re-inspection fees shall not exceed \$5,000 for any one re-inspection.

1.14 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Under provisions of Section 01 78 39.
- B. Warranties and Bonds: Under provisions of Section 01 77 19.
- C. Operations and Maintenance Manuals: Under provisions of Section 01 77 19.
- D. Evidence of Payment: In accordance with Conditions of the Contract.
- E. Certificate of Release of Liens.
- F. Contractor's Statement Concerning Claims.
- G. Miscellaneous
 - 1. As-Built Construction Schedule versus Baseline Schedule.
 - 2. Any progress photos pertinent to substantial completion/final completion.
 - 3. Final survey notes not previously transmitted.

1.15 STATEMENT OF ADJUSTMENT OF ACCOUNTS

- A. Submit final statement reflecting adjustments to Contract Price indicating:
 - 1. Original Contract Price.
 - 2. Previous Change Orders.
 - 3. Changes under allowances.
 - 4. Changes under Unit Prices.
 - 5. Deductions for uncorrected Work.
 - 6. Penalties and bonuses.
 - 7. Deductions for liquidated damages.
 - 8. Deductions for re-inspection fees.
 - 9. Other adjustments to Contract Price.
 - 10. Total Contract Price as adjusted.
 - 11. Previous payments.
 - 12. Sum remaining due.
- B. OWNER will issue a final Change Order reflecting all remaining adjustments to Contract Price not previously made by Change Orders.
- C. See Section – 01 29 73.1.04.G for minimum value for Contract Closeout Submittals.

1.16 APPLICATION FOR FINAL PAYMENT

- A. Submit Application for Final Payment in accordance with provisions of the General Conditions of the Contract.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

PART 4 - BASIS OF MEASUREMENT AND PAYMENT

4.1 BASIS OF MEASUREMENT

- A. There is no measurement for this item.

END OF SECTION

SECTION 01 78 39**PROJECT RECORD DOCUMENTS****PART 1 – GENERAL****1.1 REQUIREMENTS INCLUDED**

- A. Maintenance of Record Documents and Samples.
- B. Submittal of Record Documents and Samples.

1.2 RELATED REQUIREMENTS

- A. Section 00 72 13 General Conditions: Record Documents.
- B. Section 01 33 00 Submittals
- C. Section 01 33 23 Shop Drawings, Product Data, and Samples
- D. Section 01 77 19 Contract Closeout Procedures

1.3 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. In addition to requirements in General Conditions, maintain at the site for the Owner one accurate record copy of:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, product data, and samples.
 - 6. Survey and field records.
 - 7. Field test records.
 - 8. Inspection certificates.
 - 9. Manufacturer's certificates.
- B. Prior to Substantial Completion, provide original or legible copies of each item maintained by Contractor as listed in 1.3 A above.
- C. Delegate responsibility for maintenance of Record Documents to one person on Contractor's staff.

- D. Promptly following award of Contract, secure from OWNER, at no cost to the Contractor, one complete set of conformed Documents comprising the Contract.
- E. Immediately upon receipt of job set described above, identify each Document with title "RECORD DOCUMENTS - JOB SET".
- F. Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage for record documents and samples.
- G. Label and file record documents and samples in accordance with section number listings in table of contents of this Project manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- H. Maintain record documents in a clean, dry and legible condition. Do not use record documents for construction purposes.
- I. Use all means necessary to maintain job set of Record Documents completely protected from deterioration and from loss and damage until completion of Work and transfer of recorded data to OWNER.
- J. Keep record documents and samples available for inspection by OWNER.
- K. Upon request by OWNER and at time of each Application for Payment submit complete collection of record documents to OWNER for review and duplication as desired.
- L. OWNER's approval of current status of Record Documents will be prerequisite to OWNER's approval of requests for progress payments and request for final payment.
 - 1. Prior to submitting each request for progress payment, secure OWNER's approval of Record Documents as currently maintained.
 - 2. Prior to submitting request for Final Payment, obtain OWNER's approval of final Record Documents.
- M. Do not use job set for any purpose except entry of new data and for review and copying by OWNER.

1.4 RECORDING

- A. Record information on a set of black line opaque Drawings, and in a copy of a Project manual.
- B. Using felt tip marking pens or colored pencil, maintaining separate colors for each major system, clearly describe changes by note and by graphic

line, as required. Date all entries. Call attention to entry by a "cloud" around area or areas affected.

- C. Thoroughly coordinate all changes within Record Documents, making adequate and proper entries on each Specification Section and each sheet of Drawings and other Documents where such entry is required to properly show change or selection.
- D. When a change within Record Documents is referenced to another document, such as a DC/VR, Shop Drawing or Change Order, attach a copy of the referenced document to the respective Record Drawing or Record Specification where the entry is made.
- E. Contract Drawings and Shop Drawings: Legibly mark each item to record actual construction, including:
 - 1. Measured depths of elements of foundation in relation to finish first floor datum, accurate to the nearest inch.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements, accurate to the nearest inch.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
 - 4. Field changes of dimension and detail.
 - 5. Changes made by modifications.
 - 6. Details not on original Contract Drawings.
 - 7. References to related Shop Drawings and modifications.
 - 8. Clearly label all changes and show dimensions to establish size and location. All identifications shall be sufficiently descriptive to relate reliably to Specifications.
- F. Specifications: Legibly mark each item to record actual construction, including:
 - 1. Manufacturer, trade name, and catalog number of each product actually installed, particularly optional items and substitute items.
 - 2. Changes made by Addenda and modifications.
- G. Other Documents: Maintain manufacturer's certifications, inspection certifications, and field test records required by individual Specifications sections.

1.5 SUBMITTALS

- A. Upon submittal of the completed Record Documents, make changes in Record Documents as required by OWNER.
- B. Transmit with cover letter in duplicate, listing:
 - 1. Date.
 - 2. Authority's Project title and number.
 - 3. Contractor's name, address, and telephone number.
 - 4. Number and title of each record document.
 - 5. Signature of Contractor or authorized representative.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 019100
COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. The Commissioning Agent or Authority will be provided by the Owner and act as Owners representative. The specification defines the Commissioning Agents duties and Contractor's requirements to support the commissioning process
- B. Section Includes:
1. Commissioning description.
 2. Submittals.
 3. Qualifications
 4. Commissioning services.
 5. Commissioning responsibilities.
 6. Commissioning meetings.
 7. Commissioning reports.
 8. Sequencing.
 9. Scheduling.
 10. Maintenance materials.
 11. Test equipment.
 12. Verification check and startup procedures.
 13. Functional performance test procedures.
 14. Function performance test methods.
 15. Deficiencies and test approvals.
 16. Demonstration.
- C. Related Sections:
1. Section 230800 - Commissioning of HVAC: Mechanical systems commissioning requirements.
 2. Section 260800 – Commissioning of Electrical and Control Systems.

1.2 REFERENCES

- A. Associated Air Balance Council (AABC):
1. AABC Commissioning Guideline.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
1. ASHRAE Guideline 1 - The HVAC Commissioning Process.
- C. National Environmental Balancing Bureau (NEBB):
1. NEBB - Procedural Standards for Building Systems Commissioning.

1.3 COMMISSIONING DESCRIPTION

- A. Commissioning: Systematic process of ensuring systems perform interactively according to design intent and Owner's operational needs. Commissioning process encompasses and coordinates system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training, and verification of actual performance.
- B. Commissioning Intent:
 - 1. Verify equipment and systems are installed according to manufacturer's instructions, industry accepted minimum standards, and Contract Documents.
 - 2. Verify equipment and systems receive adequate operational checkout by Contractor.
 - 3. Verify and document proper performance of equipment and systems.
 - 4. Verify complete operation and maintenance documentation is delivered to Owner.
 - 5. Verify Owner's operating and maintenance personnel are adequately trained.
- C. Equipment and Systems to Be Commissioned: As listed in the individual specifications.
- D. Commissioning does not relieve Contractor of responsibility to provide finished and fully functioning Project.
- E. Commissioning Process Overview and General Order of Commissioning Tasks:
 - 1. Commissioning begins with initial commissioning meeting.
 - 2. Conduct progress commissioning meetings throughout construction to plan, scope, coordinate, and schedule future activities and to resolve problems.
 - 3. Equipment documentation is submitted to Commissioning Authority during normal submittals with detailed startup procedures.
 - 4. Commissioning Authority works with Contractor and equipment and system installers to develop startup plans and startup documentation formats, including verification checklists to be completed by installers, during verification check and startup process.
 - 5. In general, checkout and performance verification proceeds from simple to complex, that is, from component level to equipment to systems and intersystem levels, with verification checklists being completed before functional testing.
 - 6. Equipment and system installers execute and document verification checklists and perform verification check and startup. Commissioning Authority verifies that checklists and startup were completed according to approved plans.
 - 7. Commissioning Authority develops specific equipment and system functional performance test procedures based on submittal and design function descriptions and process requirements.
 - 8. Equipment and system installers will cooperate with the Commissioning Authority in demonstrating equipment performs as specified.
 - 9. Items of noncompliance in material, installation, or setup are corrected at Contractor's expense, and system is retested.
 - 10. Commissioning Authority reviews operation and maintenance documentation for completeness.
 - 11. Commissioning is completed before Substantial Completion.
 - 12. Commissioning Authority reviews, approves, and coordinates training provided by equipment and system installers and verifies training was completed.
 - 13. Deferred testing is conducted as specified.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures contains requirements for submittals.

1.5 COMMISSIONING SUBMITTALS

- A. Furnish one printed copy and one electronic copy of Contract Documents including Addenda, Change Orders, requests for interpretation, meeting minutes, to Commissioning Authority.
- B. Furnish one copy and one electronic copy of submittals directly to Commissioning Authority for review and approval according to procedures specified in Section 013300 - Submittal Procedures.
 - 1. Make submittals for each piece of equipment or system indicated to be submitted or commissioned.
- C. Furnish one copy and one electronic copy of preliminary operation and maintenance data manuals to Commissioning Authority for each piece of equipment or system indicated to be commissioned.
 - 1. Submit required manuals within 30 days after submittals for each piece of equipment or system required under Section 013300 - Submittal Procedures are approved.
- D. Make additional submittals requested by Commissioning Authority for each piece of equipment or system required or indicated to be commissioned. Incorporate requested submittal information into related operation and maintenance manuals. Include the following:
 - 1. Manufacturer's printed, detailed installation and startup, operating, troubleshooting, and maintenance procedures.
 - 2. Equipment performance curves.
 - 3. Factory test reports.
 - 4. Full sequence of operation and control diagrams.
 - 5. Proposed testing, adjusting, and balancing procedures.
 - 6. Complete warranty information, identifying Owner responsibilities to keep warranty in force.
 - 7. Lists of installation and checkout materials shipped with equipment.
 - 8. Manufacturer's field checkout forms to be used by factory or field technicians.
 - 9. Other documentation necessary for commissioning process.
- E. Furnish one copy and one electronic copy of manufacturers verification check and startup plan to Commissioning Authority for review and approval. Include the following at minimum:
 - 1. Commissioning Authority's verification checklists with party responsible for each item indicated.
 - 2. Manufacturer's standard startup procedures copied from installation manuals.
 - 3. Manufacturer's standard field checkout sheets.
 - 4. Supplemental procedures and checklists prepared by equipment and system installers to accommodate Project conditions.
 - 5. Sensor and actuator calibration procedures.
 - 6. Include boxes or lines for recording and documenting checking and inspections of each procedure and summary statement with signature block at end of plan.
- F. Submit written training plan to Commissioning Authority for review and approval prior to

conducting training including the following:

1. Equipment included in training session.
2. Intended audience.
3. Location of training.
4. Objectives.
5. Subjects covered.
6. Duration of training on each subject.
7. Instructor for each subject.
8. Instructional methods to be used.

- G. Commissioning Authority will review and approve submittals for conformance to Contract Documents as related to commissioning process, for primary purpose of aiding development of functional testing procedures and secondary purpose of verifying compliance with equipment Specifications.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017719 - Execution and Closeout Requirements contains requirements for closeout submittals.
- B. Operation and Maintenance Data: Submit operation and maintenance manuals as specified in individual equipment and system Specifications.
1. Submittals made to Commissioning Authority do not constitute compliance with operation and maintenance manual documentation.

1.7 COMMISSIONING SERVICES

- A. Owner will employ and pay for specified services of firm as Commissioning Authority.

1.8 COMMISSIONING RESPONSIBILITIES

- A. Responsibilities indicated for Owner, Architect/Engineer, and Commissioning Authority are provided only to clarify commissioning process.
- B. Architect/Engineer Responsibilities:
1. Perform Site observation of each system immediately before system startup.
 2. Furnish design narratives and sequence documentation requested by Commissioning Authority.
 3. Clarify operation and control of commissioned equipment when Specifications, control drawings, or equipment documentation is not sufficient for writing detailed testing procedures.
 4. Coordinate resolution of design issues affecting system performance identified during commissioning.
 5. Coordinate resolution of system deficiencies identified during commissioning, according to Contract Documents.
 6. Prepare and submit final design intent documentation reflecting installed conditions for inclusion in operation and maintenance manuals.
 7. Review and approve operation and maintenance manuals.

C. Commissioning Authority Responsibilities:

1. Basic Responsibilities:

- a. Coordinate, direct, and approve commissioning Work.
- b. Develop and coordinate execution of commissioning plan. Revise commissioning plan to suit Project conditions.
- c. Schedule commissioning Work with Contractor for inclusion in Progress Schedule.
- d. Plan and conduct commissioning meetings.
- e. Request and review commissioning submittals required to perform commissioning tasks.
- f. Write and distribute verification tests and checklists.
- g. Develop verification check and startup plan in cooperation with Contractor and equipment and system installers.
- h. Write functional performance test procedures in cooperation with Contractor and equipment and system installers.
- i. Review test and balance execution plan.
- j. Attend selected Project progress and pre-installation meetings. Review meeting minutes. Resolve potential conflicts with commissioning activities.
- k. Observe equipment and system installations.
- l. Document that equipment and systems are installed and perform according to design intent and Contract Documents.
- m. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
- n. Oversee and approve content and adequacy of Owner's personnel training.
- o. Review and approve operation and maintenance manuals.
- p. Compile commissioning record and testing data manual.
- q. Provide final commissioning report.

2. Detailed Responsibilities:

- a. Witness and document each piping, ductwork, electrical, and control and instrumentation system testing, cleaning, and flushing. Include documentation in operation and maintenance manuals.
- b. Approve verification tests and checklist completion by reviewing verification checklist reports, Site observation, and spot checking.
- c. Approve system startup by reviewing startup reports and Site observation.
- d. Oversee functional testing of control system. Approve control system for use for test and balance operations.
- e. Approve air and water system balancing by reviewing completed reports, Site observation, and spot testing.
- f. Analyze functional performance trend logs and monitor data to verify performance.
- g. Coordinate, witness, and approve manual functional performance tests performed by equipment and system installers.
 - 1) Coordinate retesting until satisfactory performance is achieved.
 - 2) Perform actual functional testing on equipment as specified in these specifications
- h. Maintain deficiency and resolution log and separate testing record. Submit progress reports and test results with recommended actions to Owner.
- i. Review equipment warranties to ensure Owner's responsibilities are defined.

D. Owner Responsibilities:

1. Arrange for Owner's personnel to attend commissioning activities and training sessions

2. according to commissioning plan.
 2. Approve commissioning Work completion.
 3. Ensure seasonal or deferred testing and deficiency issues are addressed.
- E. Contractor Responsibilities:
1. Include requirements for commissioning submittal data, operation and maintenance data, commissioning tasks and training in each purchase order and subcontract for equipment and systems indicated to be commissioned.
 2. Facilitate coordination of commissioning Work by Commissioning Authority.
 3. Attend commissioning meetings.
 4. Cooperate with Commissioning Authority, and provide access to the Work and to manufacturers' facilities.
 5. Require equipment and system installers to execute test to review and provide comments on functional test procedures.
 6. Require manufacturers to review commissioning test procedures for equipment installed by manufacturer.
 7. Furnish proprietary test equipment required by manufacturers to complete equipment and system tests.
 8. Furnish qualified personnel to assist in completing commissioning.
 9. Furnish manufacturer's qualified field representatives as specified in Section 014500 - Quality Control and individual Specification Sections to assist in completing commissioning.
 10. Ensure equipment and system installers execute commissioning responsibilities according to Contract Documents and Progress Schedule.
 11. Coordinate Owner's personnel training.
 12. Prepare operation and maintenance manuals specified in Section 017719 - Closeout Requirements. Update original sequences of operation reflecting actual installation.
 13. Ensure equipment and system installers execute seasonal and deferred functional performance testing, witnessed by Commissioning Authority.
 14. Ensure equipment and system installers correct deficiencies and make necessary adjustments to operation and maintenance manuals and record documents for issues identified in seasonal testing.

1.9 SCHEDULING

- A. Schedule Work to allow adequate time for commissioning activities.
- B. Identify commissioning milestones, activities, and durations on Progress Schedule.
 1. Identify the following for each piece of equipment and system including:
 - a. Operation and maintenance manual submittal.
 - b. Verification check and startup.
 - c. Functional performance test.
 - d. Functional completion.
 - e. Demonstration and training sessions.
 - f. Commissioning completion.

1.10 MAINTENANCE MATERIALS

- A. Section 017000 - Execution Requirements contains requirements for maintenance materials.

- B. Furnish one set of manufacturer's proprietary test equipment, tools, and instruments required to complete commissioning.
 - 1. Deliver test equipment to Owner after completion of functional performance test. Obtain signed receipt.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify equipment and systems are installed according to individual Specification Sections.
- B. Verify utility and power connections are complete and services operational.

3.2 VERIFICATION CHECK AND STARTUP PROCEDURES

- A. Notify Commissioning Authority and schedule verification check and startup activities with each party required to complete verification check and startup a minimum of four weeks in advance.
- B. Allow Commissioning Authority to witness verification check and startup.
 - 1. Equipment: Commissioning Authority will witness procedures for each piece of equipment.
- C. Verification Check and Startup:
 - 1. Perform verification check and startup according to approved verification check and startup plan.
 - 2. Complete entire plan for each piece of equipment or system indicated to be commissioned.
 - 3. Complete each procedure in sequence performed by party assigned to each procedure.
 - 4. Record completion of each procedure. Indicate results of procedure where required. Sign and date plan by individual performing procedure.
 - 5. Identify items not completed successfully.
 - 6. Sign and date plan indicating completion of entire plan.
- D. Deficiencies and Approvals:
 - 1. Commissioning Authority will review verification check and startup reports and issue deficiency report or approval.
 - 2. Correct deficiencies and resubmit updated verification check and startup report with statement indicating corrections made for Commissioning Authority approval.
 - 3. Repeat process until verification check and startup report are approved.
 - 4. Costs for incomplete verification check and startup items that later cause deficiencies or delays during functional tests may be charged to party responsible for incomplete item.

3.3 FUNCTIONAL PERFORMANCE TEST PROCEDURES

- A. Complete the following before performing functional tests:
 - 1. Verification check and startup.
 - 2. Control system testing with approval by Commissioning Authority for use for test and balance operations.
 - 3. Air system balancing and water system balancing.
- B. Notify Commissioning Authority of completion of verification check and startup activities.
- C. Commissioning Authority will direct, witness, and document results of functional performance tests.
- D. Conduct functional performance tests as specified in each section of these specifications where listed.
- E. Demonstrate that each piece of equipment and system is operating according to documented design intent and Contract Documents.
 - 1. Conduct testing proceeding from components, to subsystems, to systems.
 - 2. Bring equipment and systems to condition capable full dynamic operation.
 - 3. Verify performance of individual components and systems.
 - 4. Verify performance of interactions between systems.
 - 5. Identify and correct areas of deficient performance.
- F. Operate each piece of equipment and system through each specified mode of operation including seasonal, occupied, unoccupied, warmup, cool-down, partial load, and full load conditions.
 - 1. Verify each sequence in sequences of operation.
 - 2. Test for proper responses to power failure, freezing, overheating, low oil pressure, no flow, equipment failure, and other abnormal conditions.

3.4 FUNCTIONAL PERFORMANCE TEST METHODS

- A. Perform testing and verification by using manual testing or by monitoring performance and analyzing results using control system trend log capabilities or by standalone data loggers as specified for each piece of equipment or system.
 - 1. Commissioning Authority may require alternate or additional method other than specified method.
 - 2. Commissioning Authority will determine test method when method is not specified.
- B. Simulated Conditions: Simulating conditions, not by overwritten values, is permitted. Timing tests to use real conditions is encouraged wherever practical.
- C. Overwritten Values: Overwriting sensor values to simulate conditions may be used with caution and avoided when possible.
- D. Simulated Signals: Using signal generator to create simulated signals to test and calibrate transducers automatic temperature controls is generally recommended over using sensors as signal generators with simulated conditions or overwritten values.

- E. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test specific sequence is acceptable. Reset setpoint after completing test.
- F. Indirect Indicators: Using indirect indicators for responses or performance is permitted only after visually and directly verifying and documenting indirect readings through control system representing actual conditions and responses over tested parameter range.
- G. Perform each function and test under conditions simulating actual conditions as close as is practically possible.
 - 1. Provide materials, system modifications, and other items or steps necessary to produce flows, pressures, temperatures, and other responses to execute test according to specified conditions.
 - 2. At completion of test, return modified equipment and systems to pretest condition.
 - 3. If frequent failures occur, Commissioning Authority may stop testing and require responsible party to perform and document checkout of remaining units, prior to continuing with functional performance testing.

3.5 DEFICIENCIES AND TEST APPROVALS

- A. Deficiencies:
 - 1. Commissioning Authority will record and report deficiencies to Owner.
 - 2. Minor deficiencies may be corrected during tests at Commissioning Authority's discretion. Deficiency and resolution will be documented on procedure form.
 - 3. Failure to attend scheduled verification check, startup, or functional performance test will be considered deficiency.
 - 4. When deficiency is identified, Commissioning Authority will discuss issue with party executing test.
 - a. When party executing test accepts responsibility to correct deficiency:
 - 1) Commissioning Authority documents deficiency and executing party's response.
 - 2) Party executing test corrects deficiency, signs statement of correction on deficiency form certifying equipment is ready for retesting, and submits form to Commissioning Authority.
 - 3) Commissioning Authority reschedules test, and test is repeated until satisfactory performance is achieved.
 - b. When party executing test disputes deficiency or responsibility for deficiency:
 - 1) Commissioning Authority documents deficiency and executing party's response.
 - 2) Commissioning Authority negotiates resolution with parties involved and refers continuing disputes to Architect/Engineer for resolution according to Contract Documents.
 - 3) Commissioning Authority documents resolution process.
 - 4) When resolution is decided, appropriate party corrects deficiency, signs statement of correction on deficiency form certifying equipment is ready for retesting, and submits form to Commissioning Authority.
 - 5) Commissioning Authority reschedules test, and test is repeated until satisfactory performance is achieved.
- B. Retesting Costs:

1. When verification check and startup or functional performance test deficiency is discovered requiring rescheduling or retesting:
 - a. Owner may deduct additional testing compensation from final payment due to Contractor.
- C. Provide written report to Commissioning Authority before each scheduled commissioning meeting concerning status of each deficiency. Include explanations of disagreements with resolution proposals for each discrepancy.
 1. Commissioning Authority will retain original deficiency forms until end of Project.
- D. Test Approval: Commissioning Authority notes each satisfactorily demonstrated function on functional performance test form.
 1. Commissioning Authority recommends acceptance of each test to Owner using standard form.
 2. Owner gives final approval for each test using same form, providing signed copy to Commissioning Authority and Contractor.

3.6 DEMONSTRATION

- A. Section 017719 - Execution and Closeout Requirements contains requirements for demonstration and training.
- B. Demonstrate equipment and systems and train Owner's personnel as specified in individual equipment and system Specifications.
 1. Commissioning Authority will interview Owner's personnel to determine special needs and areas where training will be most valuable.
 2. Owner and Commissioning Authority will determine type and extent of training for each commissioned piece of equipment and system.
 3. Commissioning Authority will communicate training requirements to Contractor for benefit of equipment and system installers and manufacturers with training responsibilities.
- C. Commissioning Authority will develop criteria for determining training was satisfactorily completed, including attending some training sessions.
 1. Commissioning Authority will make recommendation to Owner regarding approval of training.

END OF SECTION 019100

DIVISION 02 EXISTING CONDITIONS

SECTION 02 41 26

SELECTIVE ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
2. Disposal of materials.
3. Storage of removed materials.
4. Identification of utilities.
5. Salvaged items.
6. Protection of items to remain as indicated on Drawings.
7. Relocate existing equipment to accommodate construction.

1.2 SCHEDULING

- A. Section 01 33 00 - Submittals: Construction Progress Schedules.
- B. Schedule work to coincide with new construction and facilitate cutovers with minimum downtime to the existing facilities.

1.3 COORDINATION

- A. Section 01 11 13 – Work Covered by Contract Documents: Coordination.
- B. Conduct demolition to minimize interference with adjacent and occupied building areas.
- C. Coordinate and sequence demolition so as not to cause unscheduled shutdown of water treatment plant or lift station operation.
- D. Identify salvage items in cooperation with Owner.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work. Notify Engineer immediately if conditions are found that conflict with the contract documents.
- B. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- C. Verify termination points for demolished services.

3.2 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Engineer before disturbing existing installation.
- B. Remove exposed abandoned conduit. Cut conduit flush with walls and floors, and patch surfaces.
- C. Where existing circuits and components/devices are disconnected, completely remove all abandoned devices, enclosures, boxes, conduit, conductors, and supports unless disconnected items are indicated to be re-purposed or reconnected.
- D. Remove abandoned conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
- E. Disconnect electrical systems in walls, floors, and ceilings as noted on Drawings and scheduled for removal.
- F. Provide temporary wiring and connections to maintain existing systems in service during construction.
- G. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.
- H. Remove, relocate, and extend existing installations to accommodate new construction.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components. Cut embedded support elements flush with walls and floors.
- K. Clean and repair existing equipment to remain.
- L. Protect and retain power to existing active equipment remaining.

- M. Cap abandoned empty conduit at both ends.

3.3 EXISTING PANELBOARDS

- A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
- B. Tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated directories where panelboard circuits have been modified or rewired.

3.4 SALVAGE ITEMS

- A. Remove and protect items indicated on Drawings to be salvaged and turn over to Owner.
- B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.5 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove equipment, materials, or fixtures which are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.

3.6 CLEANING

- A. Div 01: Requirements for Progress Cleaning and Waste Removal, and Final Cleaning.
- B. Remove demolished materials as work progresses. Legally dispose.
- C. Keep workplace neat.

3.7 PROTECTION OF FINISHED WORK

- A. Div 01: Requirements for Temporary Controls Contractor Furnished Items. Protect finished Work from damage as construction progresses.

END OF SECTION

DIVISION 22 PLUMBING

SECTION 22 05 00**COMMON WORK RESULTS FOR PLUMBING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Pipe hangers and supports.
 2. Hanger rods.
 3. Inserts.
 4. Flashing.
 5. Sleeves.
 6. Mechanical sleeve seals.
 7. Formed steel channel.

1.2 SCOPE

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

1.3 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.
- C. All Division 22 specifications apply to potable water and raw water systems. Other piping systems will fall under Division 23 specification.

1.4 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, 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.

1.5 REFERENCED CODES - LATEST ADOPTED EDITION

- | | |
|------------|-----------------------------------|
| A. NFPA 13 | Installation of Sprinkler Systems |
| B. NFPA 70 | National Electrical Code (NEC) |
| C. IMC | International Mechanical Code |
| D. UPC | Uniform Plumbing Code |
| E. IFC | International Fire Code |
| F. IFGC | International Fuel Gas Code |
| G. IBC | International Building Code |

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 in booklet or electronic form.
1. Booklet Form: The data shall be arranged and indexed under basic categories. A typewritten index shall be included with dividers and identifying tabs between sections and references to sections of specifications.
 2. Electronic Form: The data shall be provided in PDF format. The data shall be arranged and indexed under basic categories. All data must be bookmarked by section and clearly marked.
- 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.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Alaska standard and as amended by the local Authority Having Jurisdiction.
- B. Any pipe or plumbing fitting or fixture, any solder, or any flux utilized on this project shall be “lead free” in accordance with the Safe Drinking Water Act, Section 1417. “Lead free” materials utilized in domestic water system shall not contain more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.
- C. All materials utilized in domestic water system shall be certified by an ANSI accredited organization to conform to ANSI/NSF Standard 61 or NSF-61G.

1.8 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.
- B. Show the location of all valves and their appropriate tag identification.
- C. At completion of project, deliver these drawings to the owner and obtain a written receipt.

1.9 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.

1.10 SUBSTITUTIONS

- A. 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 owner shall be the final authority regarding acceptability of substitutes.

1.11 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 Engineer for consideration before proceeding with the work.

1.12 MANUFACTURER'S DIRECTIONS

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

1.13 PERMITS, FEES, ETC

- A. The Contractor under each section 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.

1.14 TESTING

- A. The Contractor under each section shall, at his own expenses, perform the various tests as specified and required by the owner and as required by applicable code, the State, and local authorities. The Contractor shall furnish all fuel and materials necessary for making tests.

1.15 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 catalog 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.

1.16 SCHEDULE OF WORK

- A. The work 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 owner will set up completion dates. Each contractor shall cooperate in establishing these times and locations and shall process his work so as to ensure the proper execution of it.

1.17 COOPERATION AND CLEANING UP

- A. The Contractor for the work under each section of the specifications shall coordinate his 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 his 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 owner, 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.

1.18 GUARANTEE

- A. Unless a longer guarantee is hereinafter called for, all work, materials and equipment items shall be guaranteed 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 Engineer, shall be repaired and/or replaced to the complete satisfaction of the Engineer. Guarantee shall be in accordance with Division 01.

1.19 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 blue-line prints, showing all changes from the original plans made during installation of the work.

2. All manufacturers' guarantees.
3. Warranties.
4. Operation and maintenance manuals.

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

2.3 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. ERICO
2. Globe
3. Hilti
4. NIBCO
5. PHS Industries
6. PHD Manufacturing
7. Substitutions: Division 01 – Product Requirements.

B. Plumbing Piping:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
6. Vertical Support: Steel riser clamp.

2.4 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.5 INSERTS

A. [Manufacturers:](#)

1. ERICO International Corporation
2. National Pipe Hanger Corporation
3. Substitutions: Division 01 – Product Requirements.

- B. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.6 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

2.7 FORMED STEEL CHANNEL

A. [Manufacturers:](#)

1. B-Line
2. Unistrut
3. Substitutions: Division 01 – Product Requirements.

- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

PART 3 - EXECUTION

3.1 DRAWINGS

- A. The mechanical drawings are generally diagrammatic. Complete details of the building, which affect the mechanical installation, may not be shown. For additional details, see Architectural 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 NFPA, IMC, IFC, UPC, IFGC and IBC Standards; all local and state amendments to all codes and standards.
- B. Compliance with codes and ordinances shall be at the Contractor's expense.

3.3 MEASUREMENTS

- A. Verify all measurements on the job site.
- B. Check all piping, ducts, etc. to clear openings.

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 eight hours of onsite instruction to the owner designated personnel.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. Submit maintenance manuals to the Engineer covering all equipment, fixtures, devices, etc. installed by the Contractor. Submit prior to substantial completion.
- B. The operation and maintenance manuals shall be bound in a loose leaf three ring binder with reinforced holes in the sheets so as to prevent lost pages. 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, fixtures, 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 valve schedule and reduced scale drawings showing valve locations.
 7. Written summary of instructions to Owner.
- C. 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.

3.6 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, 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.

3.7 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Where concrete slabs form finished ceiling, locate inserts flush with slab surface

3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 89.
- B. Support horizontal piping as scheduled.

- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.
- H. Provide copper plated hangers and supports for copper piping.
- I. Design hangers for pipe movement without disengagement of supported pipe.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 23 07 00.

3.9 INSTALLATION - SLEEVES

- A. Set sleeves in position in forms. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

3.10 SCHEDULES

PIPE SIZE Inches	POLYPROPYLENE PIPE MAXIMUM HANGER SPACING Feet	PVC PIPE MAXIMUM HANGER SPACING Feet	POLYPROPYLENE PIPE HANGER ROD DIAMETER Inches	PVC PIPE HANGER ROD DIAMETER Inches
3/4	2-2/3	4	3/8	3/8
1	2-2/3	4	3/8	3/8
1-1/4	4	4	3/8	3/8
1-1/2	4	4	3/8	3/8
2	4	4	3/8	3/8
2-1/2	4	4	1/2	1/2
3	4	4	1/2	1/2

END OF SECTION

SECTION 22 05 53**IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Labels.

1.2 REFERENCES**A. American Society of Mechanical Engineers:**

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

B. National Fire Protection Association:

1. NFPA 99 - Standard for Health Care Facilities.

1.3 SUBMITTALS**A. Division 01 - Submittal Procedures: Submittal procedures.****B. Product Data: Submit manufacturers catalog literature for each product required.****C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.****D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.****E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.**

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.6 QUALIFICATIONS

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

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Brady ID
 - 2. Seton Identification Products.
 - 3. Substitutions: Division 01 - Product Requirements.
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Plastic Tags:
 - 1. Manufacturers:
 - a. Brady ID

- b. Seton Identification Products.
 - c. Substitutions: Division 01 - Product Requirements.
 2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter or square.
- B. Metal Tags:
1. Manufacturers:
 - a. Brady ID
 - b. Seton Identification Products.
 - c. Substitutions: Division 01 - Product Requirements.
 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter or square with finished edges.

2.3 STENCILS

- A. Manufacturers:
1. Seton Identification Products.
 2. Substitutions: Division 01 - Product Requirements.
- B. Stencils: With clean cut symbols and letters of following size:
1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
 2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
 3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 4. Ductwork and Equipment: 1-3/4 inches high letters.
- C. Stencil Paint: Semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
1. Manufacturers:
 - a. Brady ID
 - b. Seton Identification Products.
 - c. Substitutions: Division 01 - Product Requirements.
 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

- C. Plastic Tape Pipe Markers:
 - 1. Manufacturers:
 - a. Brady ID
 - b. Pipemarket.com; Brimar Industries, Inc.
 - c. Seton Identification Products.
 - d. Substitutions: Division 01 - Product Requirements.
 - 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with manufacturer recommendations for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with manufacturer recommendations.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Identify pumps, glycol tanks, expansion tanks, and heat exchangers with plastic nameplates. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify valves, sensors and controls in main and branch piping with tags.
- H. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers, or stenciled painting. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 22 07 00**PLUMBING INSULATION****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Plumbing piping insulation, jackets and accessories.
2. Plumbing equipment insulation, jackets and accessories.

B. Related Sections:

1. Section 22 10 00 – Plumbing Piping

1.2 REFERENCES**A. ASTM International:**

1. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
2. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
3. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
4. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
5. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
6. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
7. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
8. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
9. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120.
10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
11. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Perform Work in accordance with State of Alaska standards and as amended by the local Authority Having Jurisdiction.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years of experience.

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. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

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 MANUFACTURER**

- A. Certain-Teed.
- B. Johns Manville.
- C. Knauf.
- D. Owens-Corning.
- E. Substitutions: Division 01 - Product Requirements.

2.2 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F.
 - 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
 - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.

2.3 PIPE INSULATION JACKETS

- A. Vapor Retarder Jacket:
 - 1. ASTM C921 white Kraft paper with glass fiber yarn, bonded to aluminized film.
 - 2. Water Vapor Permeance: ASTM E96; 0.02 perms.
- B. PVC Plastic Pipe Jacket:
 - 1. Product Description: ASTM D1785 One piece molded type fitting covers and sheet material, off-white color.
 - 2. Thickness: 10 mil.
 - 3. Connections: Pressure sensitive color matching vinyl tape.

2.4 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- C. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449.
- D. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- E. Adhesives: Compatible with insulation.

2.5 EQUIPMENT INSULATION

- A. TYPE E-1: ASTM C612; rigid fiberglass board with FSK outer facing.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 450 degrees F.
 - 3. Density: 3.0 pound per cubic foot.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify piping and equipment has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Glass Fiber Board Insulation:
 - 1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - 2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
 - 3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Inserts and Shields:
 - 1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 - 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
- F. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- G. Prepare pipe insulation for finish painting.

3.3 INSTALLATION - EQUIPMENT

- A. Install materials in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- E. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- F. Equipment Containing Fluids 140 degrees F Or Less:
 - 1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
 - 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
 - 3. Finish insulation at supports, protrusions, and interruptions.
- G. Equipment Containing Fluids Over 140 degrees F:
 - 1. Insulate flanges and unions with removable sections and jackets.
 - 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
 - 3. Finish insulation at supports, protrusions, and interruptions.
- H. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
- I. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.
- J. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.4 SCHEDULES**A. Water Supply Services Piping Insulation Schedule:**

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Domestic Cold Water	P-1	All sizes	1.0
Pipe Exposed to Freezing	P-1	All Sizes	2.0

B. Equipment Insulation Schedule:

EQUIPMENT	INSULATION TYPE	INSULATION THICKNESS inches
Water-to-Water Heat Exchangers	E-1	2

END OF SECTION

SECTION 22 10 00**PLUMBING PIPING, VALVES, AND SPECIALTIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Pipe and pipe fittings.
 - 2. Valves.
 - 3. Piping specialties.
 - 4. Plumbing supply specialties.

1.2 SUBMITTALS

- A. Product Data:
 - 1. Pipe Hangers and Supports: Submit manufacturers catalog data including load carrying capacity.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Plumbing drainage specialties: Submit manufacturers catalog information with sizes, capacities, rough-in requirements, service sizes, and finishes.
 - 4. Plumbing supply specialties: Submit manufacturers catalog information with sizes, capacities, rough-in requirements, service sizes, and finishes.
 - 5. Pumps: Include capacities, pump curves, equipment performance, and electrical characteristics.
- B. Pipe Hangers and Supports: Design data, indicate pipe sizes, load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit spare parts lists and maintenance procedures.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Alaska standard and as amended by the local Authority Having Jurisdiction.

1.5 WARRANTY

- A. Furnish five year manufacturer warranty for pumps.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. Pipe:
 - 1. ASTM D1785.
 - 2. Solvent Welded: Schedule 80.
 - 3. Threaded: Schedule 80.
- B. Fittings: ASTM D2466 or D2467.
- C. Material: PVC 1120, PVC 1220 or PVC 2120.
- D. Solvent Cement: ASTM D2564.

2.2 POLYPROPYLENE PIPE AND FITTINGS

- A. Pipe: Pipe and fittings shall be manufactured from a beta crystalline PP-RCT resin meeting the short-term properties and long-term strength requirements of ASTM F 2389 and CSA B137.11. Pipe shall be listed for potable water (shall have listings to NSF 14 and 61g). The piping shall be extruded with a middle layer that has glass fiber content to restrict thermal expansion. Pipe shall be SDR 11. Pipe shall be Niron Clima PP-RCT piping as manufactured by Nupi Americas.
- B. Fittings: Fittings shall be manufactured from a PP-RCT resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. All fittings shall comply with NSF 14, ASTM F 2389 and CSA B137.11. Fittings may be either socket fusion, electrofusion, or butt fusion.

2.3 VALVES

A. Manufacturers:

1. Bell & Gossett
2. FNW; Ferguson Enterprises, Inc.
3. Hammond Valve.
4. Milwaukee Valve Company.
5. NIBCO INC.
6. Substitutions: Division 01 - Product Requirements.

B. For potable and raw water service, provide valves complying with NSF 61.

C. Ball Valves:

1. Lead-free, Bronze or stainless steel one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle, solder or threaded ends.

D. Swing Check Valves:

1. Up to 2 inches: Lead-free bronze body and swing disc, solder or threaded ends.

E. Relief Valves:

1. Lead-free bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

2.4 PIPING SPECIALTIES

A. Flanges, Unions, and Couplings:

1. Pipe Size 2 inches and Under: Bronze unions for copper pipe, soldered joints.

B. Strainers:

1. Manufacturers:

- a. Flomatic Corporation.
- b. Hayward Flow Control; a division of Hayward Industries, Inc.
- c. Keckley Company.
- d. Matco-Norca.
- e. NIBCO INC.
- f. Zurn Industries, LLC.
- g. Substitutions: Division 01 - Product Requirements.

2. Size 2 inches and Under: Threaded brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Flexible Connectors:

1. Manufacturers:
 - a. Metraflex
 - b. Substitutions: Division 01 - Product Requirements.
2. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 300 psig.

D. Pressure Gages:

1. Manufacturers:
 - a. Weksler.
 - b. Watts; a Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
 - d. Substitutions: Division 01 - Product Requirements.
2. Gage: Lead-free bronze bourdon tube, lead-free brass socket, front calibration adjustment, black scale on white background.
 - a. Case: Steel.
 - b. Bourdon Tube: Lead-free bronze.
 - c. Dial Size: 2-1/2 inch
 - d. Mid-Scale Accuracy: 2-3 percent.
 - e. Scale: Psi.

E. Thermometers:

1. Manufacturers:
 - a. WIKA Group
 - b. KOBOLD Instruments, Inc. – USA.
 - c. Weiss Instruments, Inc.
 - d. Substitutions: Division 01 - Product Requirements.
2. Stem Type Thermometer: Solar thermometer, adjustable angle, high impact ABS case.
 - a. Display: 3/8" LCD digits.
 - b. Stem: Brass, 3/4 inch NPT.
 - c. Accuracy: 1 percent.
 - d. Calibration: Degrees F.

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 piping before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Clean, scrub, and disinfect all new piping and flanges before installation in raw and potable water systems.

3.2 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install 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, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPING SYSTEMS

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Route piping parallel to building structure and maintain gradient.
- C. Install piping to maintain headroom. Group piping to conserve space. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- F. Sleeve pipe passing through partitions, walls and floors.

- G. Install piping system allowing clearance for installation of insulation and access to valves and fittings.
- H. Install identification on piping systems. Refer to Section 22 05 53.
- I. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.4 INSTALLATION - VALVES

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install ball valves for throttling, bypass, or manual flow control services.
- D. Install swing check valves on discharge of pumps.
- E. Install 3/4 inch ball drain valves at low points of piping, and at equipment.

3.5 INSTALLATION - PIPING SPECIALTIES

- A. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples and siphons to allow clearance from insulation.
- B. Install thermometers in piping systems in sockets in short couplings, and in accordance with manufacturer instructions. Allow clearance from insulation.
- C. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- D. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- E. Provide drain and hose connection with valve on strainer blow down connection.

3.6 INSTALLATION - PLUMBING SUPPLY PIPING

- A. Install water piping in accordance with ASME B31.9.
- B. Slope water piping and arrange to drain at low points.
- C. Install piping from relief valves, and drains to within 6" of finished floor
- D. Install flow controls in water circulating systems as indicated on Drawings.

3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- B. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual. Bleed water from outlets to accomplish distribution.
- C. Maintain disinfectant in system for 24 hours. When final disinfectant residual tests less than 25 mg/L, repeat treatment.
- D. Flush disinfectant from system. Take samples no sooner than 24 hours after flushing, and analyze in accordance with AWWA C651.

END OF SECTION

SECTION 22 21 23**PLUMBING PUMPS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. VFD Controlled in-line circulators

B. Related Sections:

1. Section 23 05 00 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 05 23 - General-Duty Valves for HVAC Piping: Product requirements for valves used in hydronic piping systems.
3. Section 23 05 03 - Hydronic Piping: Execution requirements for connection to pumps specified by this section.
4. Section 23 21 16 - Hydronic Piping Specialties: Product and execution requirements for piping specialties installed in hydronic systems adjacent to pumps.
5. Division 26 - Equipment Wiring Connections: Execution requirements for electrical connections to pumps specified by this section.

1.2 WORK INCLUDED

- A. This specification section applies to any pump that is in contact with the potable water and raw water systems, specifically CP-E in the design documents. Other pumps will fall under Division 23 specification.

1.3 REFERENCES**A. National Electrical Manufacturers Association:**

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. Underwriters Laboratories Inc.:

1. UL 778 - Motor Operated Water Pumps.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide pumps to operate at system fluid temperatures indicated on Drawings without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.5 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- C. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.7 QUALIFICATIONS

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

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for pumps.

1.11 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 - PRODUCTS

2.1 VFD CONTROLLED IN-LINE CIRCULATORS

- A. Manufacturers:
 - 1. Grundfos.
 - 2. Substitutions: Division 01 - Product Requirements.
- A. The pumps shall be canned rotor type, the pump and motor shall form an integral unit without shaft seal and with only two gaskets for sealing. The bearings shall be lubricated by the pumped liquid.
- B. All casings shall be flanged connections.
- C. Stainless steel pump housing, composite impeller, ceramic shaft and stainless steel rotor can and bearing plate. Pump construction to comply with the requirements of NSF 61. The pump housing and pump head shall be electrocoated to improve the corrosion resistance. The electrocoating shall include: alkaline cleaning, pretreatment with zinc phosphate coating, cathodic electrocoating and curing of paint film at 392 to 482 Deg F.
 - 1. The pump shall have the following features;
 - 2. Controller integrated in the control box.
 - 3. Control Panel on the Control Box.
 - 4. Control Box prepared for optional control modules.
 - 5. Built in Differential Pressure Temperature and Sensor.
 - 6. Internal motor overload protection.
 - 7. Insulating shells supplied with pumps.

- D. The motor and electronic controller shall incorporate a 4-pole synchronous, permanent magnet motor. The pump speed shall be controlled by an integrated frequency controller. A differential pressure sensor shall be incorporated into the pump.
- E. Integrated Variable Speed Drive: The VSD shall be designed and manufactured by the same manufacturer as the pump. The VSD shall be factory installed on the motor. The VSD enclosure class shall be IP44. The VSD shall have the human interface options of:
 - 1. Control panel on the VSD face.
 - 2. Building Automation Systems Interface
 - 3. The VSD shall be able controlled by the signals from a single sensor. The acceptable sensors signal is 4 to 20 mA. or 10-10 Vdc signals.
 - 4. VSD shall allow one digital input and one set point input.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings.
- C. Install flexible connectors at or near pumps where piping configuration does not absorb vibration. Refer to Section 22 10 00.
- D. Lubricate pumps before start-up.

3.2 FIELD QUALITY CONTROL

- A. Division 01 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION

SECTION 22 35 00**DOMESTIC WATER HEAT EXCHANGERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Potable and raw water water heat exchangers.
- B. Related Sections:
 - 1. Section 22 07 00 - Plumbing Insulation
 - 2. Section: 22 10 00 - Plumbing Piping

1.2 WORK INCLUDED

- A. This specification section applies to any heat exchangers that are in contact with the potable and raw water systems, specifically HX-B and HX-D in the design documents. Other heat exchangers will fall under Division 23 specification.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME PTC 25 - Pressure Relief Devices.
 - 2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate heat exchanger dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.
- C. Product Data: Submit dimensioned drawings of heat exchangers indicating components and connections to other equipment and piping. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.6 QUALITY ASSURANCE

- A. Conform to ASME for construction of heat exchangers.
- B. Perform Work in accordance with State of Alaska standard and as amended by the local Authority Having Jurisdiction.
- C. Any pipe or plumbing fitting or fixture, any solder, or any flux utilized on this project shall be “lead free” in accordance with the Safe Drinking Water Act, Section 1417. “Lead free” materials utilized in domestic water system shall not contain more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.
- D. All materials utilized in domestic water system shall be certified by an ANSI accredited organization to conform to ANSI/NSF Standard 61, NSF-61G or KIWA.

1.7 QUALIFICATIONS

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

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Products storage and handling requirements.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for heat exchangers.

PART 2 - PRODUCTS**2.1 DOMESTIC WATER HEAT EXCHANGERS**

- A. Manufacturers:
 - 1. SWEP
 - 2. Kelvion.
 - 3. Taco, Inc.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Construction: Braze alloy to be copper 99.9% and connector to be 304 stainless steel.
- C. Plates: Double wall, stainless steel Type 316L.
- D. Maximum allowable working pressure rating 650 psig and temperature rating 350°F.
- E. NSF 61 compliant.
- F. Heat Exchanger Performance: See schedule on drawings.
- G. Accessories:
 - 1. Wells for temperature regulator sensor at heated water outlet.
 - 2. ASME rated pressure and temperature relief valve as indicated on drawings
 - 3. Thermometers and pressure gauge taps on water inlets and outlets.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install the following piping accessories.
 - 1. On supply:
 - a. Thermometer well and thermometer.
 - b. Strainer.
 - c. Pressure gage.

- d. Shutoff valve.
- 2. On return:
 - a. Thermometer well and thermometer.
 - b. Pressure gage.
 - c. Shutoff valve.
- B. Install discharge piping from relief valves and drain valves to within 6" of finished floor.
- C. Support new heat exchangers per detail in design drawings.

END OF SECTION

DIVISION 23 - MECHANICAL

SECTION 23 05 00**COMMON WORK RESULTS FOR HVAC****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Pipe hangers and supports.
 2. Hanger rods.
 3. Inserts.
 4. Flashing.
 5. Sleeves.
 6. Mechanical sleeve seals.
 7. Formed steel channel.

1.2 SCOPE

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

1.3 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.
- C. All Division 23 specifications apply to waste heat and building heat water systems. Raw water and potable water fall under Division 22 specifications.

1.4 RELATED WORK

- A. Related Work Specified Elsewhere:
1. Electrical Specifications: 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, 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.

1.5 REFERENCED CODES - LATEST ADOPTED EDITION

- A. NFPA 70 National Electrical Code (NEC)
- B. IMC International Mechanical Code
- C. UPC Uniform Plumbing Code
- D. IFC International Fire Code
- E. IFGC International Fuel Gas Code
- F. IBC International Building Code

1.6 SUBMITTALS

- A. Submit by specification section complete and all at one time; partial submittals will not be considered. Submittals shall be in booklet or electronic form.
 - 1. Booklet Form: The data shall be arranged and indexed under basic categories. A typewritten index shall be included with dividers and identifying tabs between sections and references to sections of specifications.
 - 2. Electronic Form: The data shall be provided in PDF format. The data shall be arranged and indexed under basic categories. All data must be bookmarked by section and clearly marked.
- B. 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.
- C. Only submit on items specifically required by each specification section. If a submittal has not been requested, it will be returned to the Contractor and will not be reviewed.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Alaska standards and as amended by the local authority having jurisdiction.
- B. Perform work with skilled craftsman specializing in said work. Install all materials in a neat and orderly, and secure fashion as required by specifications and commonly recognized standards of good workmanship.

1.8 SUBSTITUTIONS

- A. 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.
- B. The owner shall be the final authority on acceptability of substitutions.

1.9 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 Engineer for consideration before proceeding with the work.

1.10 MANUFACTURER'S DIRECTIONS

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

1.11 PERMITS, FEES, ETC.

- A. The Contractor under each section 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.

1.12 TESTING

- A. The Contractor under each section shall, at his own expenses, perform the various tests as specified and required by the owner and as required by applicable code, the State, and local authorities.
- B. The Contractor shall furnish all fuel and materials necessary for making tests.

1.13 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 catalog 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.

1.14 SCHEDULE OF WORK

- A. The work 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.
- B. The owner will set up completion dates. Each contractor shall cooperate in establishing these times and locations and shall process his work so as to ensure the proper execution of it.

1.15 COOPERATION AND CLEANING UP

- A. The contractor for the work under each section of the specifications shall coordinate his 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 his 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 owner, 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.

1.16 WARRANTY

- A. Warranty shall be in accordance with Division 01.
- B. Unless a longer warranty is called for within project specifications, all work, materials and equipment items shall be guaranteed 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 or Engineer, shall be repaired and/or replaced to the complete satisfaction of the Architect/Engineer.

1.17 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 showing all changes from the original plans made during installation of the work.
 - 2. All manufacturers' guarantees.
 - 3. Warranties.
 - 4. Operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide all equipment and materials required for a complete system.
- B. All equipment and materials supplied under this Contract are new unless specifically indicated as existing, Where additional or replacement items are required, provide like items by the same manufacturer to the maximum extent practical.
- C. Install all material and equipment in accordance with manufacturer's installation instructions and recommendations unless specifically indicated.

2.2 ELECTRICAL MOTORS

- A. 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. Size motors for 1.15 service factor.
- D. Fractional horsepower motors to have self-resetting thermal overload switch.
- E. Provide Premium Efficiency, motors for all three phase motors one horsepower and larger. Standard efficiency motors will not be acceptable.

2.3 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.

2.4 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. ERICO
 - 2. Globe
 - 3. Hilti
 - 4. NIBCO
 - 5. PHS Industries
 - 6. PHD Manufacturing
 - 7. Substitutions: Division 01 – Product Requirements.
- B. Hydronic Piping:
 - 1. Conform to ASME B31.9.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
 - 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 6. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Copper Pipe Support: Copper-plated, carbon steel ring.

2.5 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.6 INSERTS

- A. Manufacturers:
 - 1. ERICO International Corporation
 - 2. National Pipe Hanger Corporation
 - 3. Substitutions: Division 01 – Product Requirements.
- B. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.7 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

2.8 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. B-Line
 - 2. Unistrut
 - 3. Substitutions: Division 01 – Product Requirements.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

PART 3 - EXECUTION

3.1 DRAWINGS

- A. The mechanical drawings are generally diagrammatic and do not necessarily show all features of the required work. Complete details of the building, which affect the mechanical installation, may not be shown. For additional details, see Architectural, and Electrical Drawings. Coordinate work under this section with that of all related trades.
- B. Contractor to field verify all dimensions and conditions prior to start of construction. Immediately contact the Engineer for clarification of questionable items or apparent conflicts.

3.2 INSTALLATION

- A. All work shall comply with the latest adopted applicable codes and ordinances including, but not limited to, the NFPA, IMC, IFC, UPC, IFGC and IBC Standards; all local and state amendments to all codes and standards.
- B. Compliance with codes and ordinances shall be at the Contractor's expense.

3.3 MEASUREMENTS

- A. Verify all measurements on the job site.
- B. Check all piping, ducts, etc. to clear openings.

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 mechanical systems and equipment.
- B. The Operation and Maintenance Manuals shall be utilized for the basis of the instruction. Provide a minimum of four hours of onsite instruction to the owner designated personnel.

3.5 OPERATING AND MAINTENANCE MANUALS

- A. Submit maintenance manuals to the Engineer covering all equipment, fixtures, devices, etc. installed by the Contractor. Submit prior to substantial completion. A separate chapter is required for each section of the specifications with subchapters for each class of equipment or system.
- B. The operation and maintenance manuals shall be bound in a loose leaf three ring binder with reinforced holes in the sheets so as to prevent lost pages. 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. A table of contents for each chapter listing each major item with a page or mark number. Each page of the manual is to be numbered.
 - 3. Catalog cuts of all equipment, fixtures, etc. installed (Marked to identify the specific items used). Equipment identification is to be the same as shown on nameplates, i.e. HX-1, CP-1, etc.
 - 4. Manufacturer's maintenance and overhaul instruction booklets including exploded views.
 - 5. Manufacturer's required spare parts list for all equipment with replaceable parts.
 - 6. Identification numbers of all parts and nearest sources for obtaining parts and services.

7. Reduced scale drawings of the control system and a verbal description of how these controls operate.
 8. A copy of valve schedule and reduced scale drawings showing valve locations.
- C. Operating Sequence Narrative: To be typewritten and in outline form. In each chapter, describe procedures necessary to operate equipment covered by chapter. Include procedures for start-up, shut down, and emergency operation. Provide a description of all adjustments necessary or optional.
- D. Maintenance Instructions: In each chapter describe maintenance procedures for equipment covered by the chapter. Include manufacturer's recommended preventive/periodic maintenance form that includes all of the equipment provided with the maintenance manual. This shall be a standalone document, which can be used independent of the rest of the operations and 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. Maintenance instructions shall include instructions for minor repairs that could be reasonably performed by persons qualified to operate the equipment and perform day-to-day maintenance.
- E. Include instruction in the use of the completed and approved Operations and Maintenance Manual as part of the required training for Owner Personnel.

3.6 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Where concrete slabs form finished ceiling, locate inserts flush with slab surface

3.7 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 89.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.

- H. Provide copper plated hangers and supports for copper piping.
- I. Design hangers for pipe movement without disengagement of supported pipe.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 23 07 00.

3.8 INSTALLATION - SLEEVES

- A. Set sleeves in position in forms. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

3.9 SCHEDULES

- A. Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
3/4	6	12	3/8	3/8
1	6	12	3/8	3/8
1-1/4	6	12	3/8	3/8
1-1/2	10	12	3/8	3/8
2	10	12	3/8	3/8
2-1/2	10	12	1/2	1/2
3	10	12	1/2	1/2

END OF SECTION

SECTION 23 05 03**PIPES AND TUBES FOR HVAC****PART 1 - GENERAL****1.1 SUMMARY**

A. Section Includes: Pipe and pipe fittings for the following systems:

1. Heating water piping.
2. Heating glycol piping.
3. Equipment drains and over flows.
4. Fuel oil piping.
5. Fuel oil protector piping.
6. Unions and flanges.
7. Valves

B. Related Sections:

1. Section 23 07 00 - HVAC Insulation: Product requirements for piping insulation for placement by this section.
2. Section 23 21 16 - Hydronic Piping Specialties: Product requirements for hydronic piping specialties for placement by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.4 - Gray Iron Threaded Fittings.
3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
5. ASME B31.1 - Power Piping.
6. ASME B31.9 - Building Services Piping.
7. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.

B. ASTM International:

1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM B32 - Standard Specification for Solder Metal.

4. ASTM B75 - Standard Specification for Seamless Copper Tube.
 5. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- C. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- D. National Fire Protection Association:
1. NFPA 30 - Flammable and Combustible Liquids Code.
 2. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.
 3. NFPA 54 - National Fuel Gas Code.
 4. NFPA 58 - Liquefied Petroleum Gas Code.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- D. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- B. Perform Work in accordance with State of Alaska standards and as amended by the local authority having jurisdiction.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing work of this section with minimum years' experience.
- C. Design pipe hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Alaska.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 COORDINATION

- A. Division 01 - Administrative Requirements: Requirements for coordination.

PART 2 - PRODUCTS**2.1 HEATING WATER PIPING, ABOVE GROUND**

- A. Copper Tubing: ASTM B88, Type L drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 - 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
 - 3. Joints: ASTM B32, AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.

2.2 HEATING GLYCOL PIPING, ABOVE GROUND

- A. Copper Tubing: ASTM B88, Type L drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 - 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
 - 3. Joints: ASTM B32, AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53 Schedule 40, galvanized.
 - 1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.
 - 2. Joints: Threaded for pipe 2 inch and smaller; flanged for pipe 2-1/2 inches and larger.
- B. Copper Tubing: ASTM B88, Type L, drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 - 2. Joints: ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, lead free solder.

2.4 FUEL OIL PIPING - ABOVE GROUND

- A. Steel Pipe: ASTM A53 or ASME B36.10M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234 wrought carbon steel and alloy steel welding type.
 - 2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

2.5 FUEL OIL PIPE COATING SYSTEM

- A. Above Grade Pipe:
 - 1. Prime pipe and fittings prior to shipping from factory. Prepare outer pipe and fitting surfaces by wheel abrading or sandblasting to bare metal. Prime with universal red oxide primer (Devoe Rustguard 4160 OAE) to 1.5 mils minimum DFT.
 - 2. After field fabrication is complete, top coat primed pipe and fittings with two coats of ALKYD enamel (Devoe Speedenamel 4318 OAE). Coordinate color with Owner.
 - 3. Provide flow direction arrows on all above grade piping. Arrows may be painted stencils or high quality printed stickers. Maximum flow direction arrow spacing shall be 10 feet measured along pipe length, minimum of one arrow per pipe segment. Color shall be black.

2.6 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Ferrous Piping: Class 150, malleable iron, threaded.
 - 2. Copper Piping: Class 150, bronze unions with [soldered] [brazed joints].
 - 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Copper Piping: Class 150, slip-on bronze flanges.
 - 3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.7 BALL VALVES

- A. Manufacturers:
 - 1. Hammond Valve
 - 2. Milwaukee
 - 3. NIBCO
 - 4. FNW
 - 5. Conbraco Industries
 - 6. Substitutions: Division 01 – Product Requirements.

- B. Up to 2-1/2 Inches: Class 150, bronze two piece body, full port, forged brass, chrome plated ball, Teflon seats and stuffing box ring, blow-out proof stem, lever handle solder or threaded ends with union. Seat material to be compatible with fluid handled.

2.8 CHECK VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America.
 - 2. Hammond Valve.
 - 3. Milwaukee Valve Company.
 - 4. NIBCO, Inc.
 - 5. Stockham Valves & Fittings.
 - 6. Substitutions: Division 01 - Product Requirements.

- B. Horizontal Swing Check Valves:
 - 1. Up to 2 Inches: Class 125, bronze swing disc, solder or screwed ends.
 - 2. Over 2 Inches: Class 125, iron body, bronze trim, swing disc, renewable disc and seat, flanged ends.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.

3.2 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. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - ABOVE GROUND PIPING

- A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 00.
- G. Provide access where valves and fittings are not accessible.
- H. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- I. Slope piping and arrange systems to drain at low points.
- J. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

- K. Install hydronic piping specialties in accordance with Section 23 21 16.
- L. Insulate piping. Refer to Section 23 07 00.
- M. Install pipe identification in accordance with Section 23 05 53.

3.4 INSTALLATION - ABOVEGROUND FUEL OIL PIPING

- A. Install fuel oil piping in accordance with NFPA 31.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals. Install in accordance with NACE RP-01-69.

3.5 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- D. Install valves with clearance for installation of insulation and allowing access.
- E. Provide access where valves and fittings are not accessible.
- F. Refer to Section 23 07 00 for insulation requirements for valves.

3.6 VALVE APPLICATIONS

- A. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section.
- B. Install ball for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install ball for throttling, bypass, or manual flow control services.
- D. Install swing check valves on discharge of water pumps.
- E. Install ball valves in heating water systems for shut-off service.
- F. Install ball valves in fuel oil systems for shut-off service.

3.7 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Test glycol piping system in accordance with ASME B31.1.
- C. Pressure test fuel oil piping in accordance with NFPA 31.

3.8 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.
- B. After completion, fill, clean, and glycol piping system.

END OF SECTION

SECTION 23 05 53**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Labels.

B. Related Sections:

1. 23 05 03 – Pipes and Tubes for HVAC Piping and Equipment
2. 23 05 23 – General Duty Valves for HVAC Piping
3. 23 21 16 – Hydronic Piping Specialties
4. 23 21 23 – Hydronic Pumps
5. 23 57 00 – Heat Exchangers for HVAC

1.2 REFERENCES**A. American Society of Mechanical Engineers:**

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS**A. Division 01 - Submittal Procedures: Submittal procedures.****B. Product Data: Submit manufacturers catalog literature for each product required.**

- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.6 QUALIFICATIONS

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

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers; Nameplates:
 - 1. Seton Identification Products.
 - 2. Substitutions: Division 01 - Product Requirements.

- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:

- 1. Manufacturers:
 - a. Brady ID
 - b. Seton Identification Products.
 - c. Substitutions: Division 01 - Product Requirements.
- 2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter or square.

B. Metal Tags:

- 1. Manufacturers:
 - a. Brady ID
 - b. Seton Identification Products.
 - c. Substitutions: Division 01 - Product Requirements.
- 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter or square with finished edges.

C. Information Tags:

- 1. Manufacturers:
 - a. Brady ID
 - b. Seton Identification Products.
 - c. Substitutions: Division 01 - Product Requirements.
- 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

D. Tag Chart: Typewritten letter size list of applied tags and location plastic laminated.

2.3 STENCILS

A. Manufacturers:

- 1. Seton Identification Products.
- 2. Substitutions: Division 01 - Product Requirements.

- B. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
 - 2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
 - 3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 - 4. Equipment: 1-3/4 inches high letters.
- C. Stencil Paint: Semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
 - 1. Manufacturers:
 - a. Brady ID
 - b. Seton Identification Products.
 - c. Substitutions: Division 01 - Product Requirements.
 - 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers:
 - 1. Manufacturers:
 - a. Brady ID
 - b. Pipemarker.com; Brimar Industries, Inc.
 - c. Seton Identification Products.
 - d. Substitutions: Division 01 - Product Requirements.
 - 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.5 LABELS

- A. [Manufacturers](#):
 - 1. Brady ID.
 - 2. Seton Identification Products.
 - 3. Substitutions: Division 01 - Product Requirements.
- B. Description: Polyester, size 1.9 x 0.75 inches, adhesive backed with printed identification.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with manufacturer's recommendations for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with manufacturer's recommendations.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Identify heat exchangers, expansion tanks, and glycol tanks with plastic nameplates. Identify in-line pumps and other small devices, including instrumentation and controls with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Tag automatic controls, instruments, and relays. Key to control schematic.
- J. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers, or stenciled painting. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 23 05 93**TESTING, ADJUSTING, AND BALANCING FOR HVAC****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Testing adjusting, and balancing of hydronic systems.
 - 2. Measurement of final operating condition of HVAC systems.
- B. Related Sections:

1.2 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- B. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- C. Testing Adjusting and Balancing Bureau:
 - 1. TABB - International Standards for Environmental Systems Balance.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- C. Test Reports: Indicate data on NEBB Report forms.
- D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms.

- F. Submit draft copies of report for review prior to final acceptance of Project.
- G. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of balancing valves and rough setting.
- C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Alaska standard and as amended by the local Authority Having Jurisdiction.
- B. Perform Work in accordance with NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems
- C. Maintain one copy of each document on site.
- D. Prior to commencing Work, calibrate each instrument to be used.

1.6 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years' experience Certified by NEBB.

1.7 SEQUENCING

- A. Division 01 - Summary: Work sequence.
- B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.8 SCHEDULING

- A. Division 01 - Administrative Requirements: Coordination and project conditions.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. HVAC control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Hydronic systems are flushed, filled, and vented.
 - 5. Pumps are rotating correctly.
 - 6. Proper strainer baskets are clean and in place or in normal position.
 - 7. Service and balancing valves are open.

3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

- A. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance.

- F. Leave systems in proper working order, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 WATER SYSTEM PROCEDURE

- A. Adjust water systems to obtain design quantities.
- B. Use calibrated fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.
- C. Confirm air bleeds indicate system is full of water.
- D. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- E. Perform system balance with automatic control valves fully open, and pump VFDs at 100 percent speed.
- F. Confirm pump rotation and differential pressure at full flow.
- G. Perform adjustment of water distribution systems by the following measures:
 - 1. Reduce total system flow rate first by reducing speed of VFD.
 - 2. Use balancing cocks, valves, and fittings.
- H. Do not use service or shut-off valves for balancing unless designed for balancing and shut-off functions. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

END OF SECTION

SECTION 23 07 00**HVAC INSULATION****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. HVAC piping insulation, jackets and accessories.
2. HVAC equipment insulation, jackets and accessories.

B. Related Sections:

1. Section 23 05 00 – Common Work Results for HVAC.
2. Section 23 05 03 – Pipes and Tubes for HVAC

1.2 REFERENCES**A. ASTM International:**

1. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
2. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
3. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
4. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
5. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
6. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
7. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
8. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
9. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
10. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
11. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
12. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
13. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

14. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
15. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
16. ASTM E2231 - Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- B. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- C. Duct insulation, Coverings, and Linings: Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.
- D. Perform Work in accordance with State of Alaska standard and as amended by the local Authority Having Jurisdiction.

1.5 QUALIFICATIONS

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

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. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

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.
- B. Furnish five year manufacturer warranty for manmade fiber.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:
 - 1. CertainTeed.
 - 2. Knauf.
 - 3. Johns Manville.
 - 4. Owens-Corning.
 - 5. Substitutions: Division 01 - Product Requirements.

2.2 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.

2. Operating Temperature Range: 0 to 850 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

2.3 PIPE INSULATION JACKETS

A. Vapor Retarder Jacket:

1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

B. PVC Plastic Pipe Jacket:

1. Product Description: One piece molded type fitting covers and sheet material, off-white color.
2. Thickness: 10 mil

2.4 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

G. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

H. Adhesives: Compatible with insulation.

2.5 EQUIPMENT INSULATION

A. TYPE E-1: ASTM C612; rigid fiberglass board with FSK outer facing.

1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 450 degrees F.

3. Density: 3.0 pound per cubic foot.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify piping, equipment and ductwork has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Hot Piping Systems less than 140 degrees F:
 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.
- B. Hot Piping Systems greater than 140 degrees F:
 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 3. Insulate flanges and unions at equipment.
- C. Inserts and Shields:
 1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
 3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.

- D. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers or aluminum jacket.

3.3 INSTALLATION - EQUIPMENT

- A. Install materials in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- E. Equipment Containing Fluids 140 degrees F Or Less:
 - 1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
 - 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
 - 3. Finish insulation at supports, protrusions, and interruptions.
- F. Equipment Containing Fluids Over 140 degrees F:
 - 1. Insulate flanges and unions with removable sections and jackets.
 - 2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
 - 3. Finish insulation at supports, protrusions, and interruptions.
- G. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
- H. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.
- I. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.4 SCHEDULES

A. Heating Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Heating Water/Glycol Supply and Return	P-1	All	1.0

B. Equipment Insulation Schedule:

EQUIPMENT	INSULATION TYPE	INSULATION THICKNESS inches
Water-to-Water Heat Exchangers	E-1	2

END OF SECTION

SECTION 23 08 00**COMMISSIONING OF HVAC****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. HVAC commissioning description.
2. HVAC commissioning responsibilities.

B. Related Sections:

1. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: For requirements and procedures concerning testing, adjusting, and balancing of mechanical systems.
2. Section 23 09 00 - Instrumentation and Control for HVAC: Submittal and training requirements.

1.2 REFERENCES**A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:**

1. ASHRAE Guideline 1 - The HVAC Commissioning Process.

B. Building Commissioning Association:

1. BCA - Commissioning Handbook.

C. National Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Building Systems Commissioning.

D. Testing Adjusting and Balancing Bureau:

1. TABB - Commissioning Manual.

1.3 COMMISSIONING DESCRIPTION**A. HVAC commissioning process includes the following tasks:**

1. Testing and startup of HVAC equipment and systems.
2. Equipment and system verification checks.
3. Assistance in functional performance testing to verify testing and balancing, and equipment and system performance.
4. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
9. Provide training for systems specified in this Section with coordination by Commissioning Authority.

B. Equipment and Systems to Be Commissioned:

1. New HVAC systems that were installed under this Contract.

C. The following is a partial list of equipment that may be included in this HVAC Commissioning:

1. Pumps.
2. Piping systems.
3. Variable frequency drives.
4. Heat exchangers.
5. HVAC control system.
6. Testing, Adjusting and Balancing work.

D. Perform seasonal function performance tests for the following equipment and systems:

1. Heating equipment during heating season.

1.4 COMMISSIONING SUBMITTALS

- A. Division 01 - Commissioning: Requirements for commissioning submittals.
- B. Draft Forms: Submit draft of system verification form and functional performance test checklist.
- C. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified. Use NEBB forms as guidelines.
- D. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.
- C. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASHRAE Guideline 1 requirements.

1.7 COMMISSIONING RESPONSIBILITIES

- A. Equipment or System Installer Commissioning Responsibilities:
 - 1. Attend commissioning meetings.
 - 2. Ensure temperature controls installer performs assigned commissioning responsibilities as specified below.
 - 3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
 - 4. Provide instructions and demonstrations for Owner's personnel.
 - 5. Ensure subcontractors perform assigned commissioning responsibilities.
 - 6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
 - 7. Develop startup and initial checkout plan using manufacturer's startup procedures and functional performance checklists for equipment and systems to be commissioned.
 - 8. During verification check and startup process, execute HVAC related portions of checklists for equipment and systems to be commissioned.
 - 9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
 - 10. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
 - 11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
 - 12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
 - 13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
 - 14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When

deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.

15. Perform verification checks and startup on equipment and systems as specified.
16. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.
17. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
18. Conduct HVAC system orientation and inspection.

B. Temperature Controls Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Review design for ability of systems to be controlled including the following:
 - a. Confirm proper hardware requirements exists to perform functional performance testing.
 - b. Confirm proper safeties and interlocks are included in design.
 - c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
 - d. Confirm sensors selected are within device ranges.
 - e. Review sequences of operation and obtain clarification from Architect/Engineer.
3. Inspect, check, and confirm proper operation and performance of control hardware provided in other HVAC sections.
4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer.
5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan and requirements of Section 23 09 00.
7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

C. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes. Repeat sample of 10 percent of measurements contained in testing, adjusting, and balancing report as selected by Commissioning Authority.
3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.8 COMMISSIONING MEETINGS

- A. Division 01 - Commissioning: Requirements for commissioning meetings.
- B. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.9 SCHEDULING

- A. Division 01 - Administrative Requirements: Requirements for scheduling.
- B. Prepare schedule indicating anticipated start dates for the following:
 - 1. Piping system pressure testing.
 - 2. Piping system flushing and cleaning.
 - 3. Equipment and system startups.
 - 4. Automatic temperature control system checkout.
 - 5. Testing, adjusting, and balancing.
 - 6. HVAC system orientation and inspections.
 - 7. Operation and maintenance manual submittals.
 - 8. Training sessions.

1.10 COORDINATION

- A. Division 01 - Administrative Requirements: Requirements for coordination.
- B. Notify Commissioning Authority minimum of four weeks in advance of the following:
 - 1. Scheduled equipment and system startups.
 - 2. Scheduled automatic temperature control system checkout.
 - 3. Scheduled start of testing, adjusting, and balancing work.
- C. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install additional balancing valves, test ports, and pressure and temperature taps required by Commissioning Authority.
- B. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.

3.2 FIELD TESTS AND INSPECTIONS

- A. Seasonal Sensitive Functional Performance Tests:
 - 1. Test heating equipment at winter design temperatures.
 - 2. Participate in testing delayed beyond Substantial Completion to test performance at peak seasonal conditions.
- B. Be responsible to participate in initial and alternate peak season test of systems required to demonstrate performance.

END OF SECTION

SECTION 23 21 16**HYDRONIC PIPING SPECIALTIES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Pressure gages.
2. Pressure gage taps.
3. Thermometers.
4. Thermometer supports.
5. Test plugs.
6. Flexible connectors.
7. Diaphragm-type expansion tanks.
8. Air vents.
9. Air separators.
10. Strainers.
11. Balance valves.
12. Relief valves.
13. Glycol charging equipment.
14. Glycol solution.

B. Related Sections:

1. Section 23 05 03 – Pipes and Tubes for HVAC.
2. Section 23 21 23 - Hydronic Pumps.

1.2 REFERENCES**A. American Society of Mechanical Engineers:**

1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.
2. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

1.3 PERFORMANCE REQUIREMENTS

- A. Flexible Connectors: Provide at or near pumps where piping configuration does not absorb vibration.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit for manufactured products and assemblies used in this Project.
 - 1. Manufacturer's data indicating use, operating range, total range, accuracy, and location for manufactured components.
 - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
 - 4. Submit electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.
- D. 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 actual locations of components and instrumentation.
- C. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

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. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements.
- B. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements before fabrication.

1.10 WARRANTY

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

1.11 MAINTENANCE SERVICE

- A. Division 01 - Execution and Closeout Requirements: Maintenance service.

1.12 MAINTENANCE MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance materials.

1.13 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

- A. Manufacturers:
 - 1. Weksler
 - 2. Dwyer.
 - 3. Trerice.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Gage: ASME B40.1, with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
- C. Case: Steel.
- D. Bourdon Tube: Phosphor bronze.
 - 1. Dial Size: 3-1/2 inch diameter.
 - 2. Mid-Scale Accuracy: 2-3 percent.
 - 3. Scale: Dual Scale, PSI and kPa.

2.2 PRESSURE GAGE TAPS

- A. Manufacturers:
 - 1. Weksler
 - 2. Dwyer.
 - 3. Trerice.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.
- C. Ball Valve: Brass, 1/4 inch NPT for 250 psi.
- D. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.
- E. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. WIKA Group
 - 2. Trerice.

3. Substitutions: Division 01 - Product Requirements.
- B. Thermometer: Solar thermometer, adjustable angle, high impact ABS case.
1. Display: 3/8" LCD.
 2. Stem: Brass, 3/4 inch NPT.
 3. Accuracy: 1 percent.
 4. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

- A. Manufacturers:
1. Sisco.
 2. Substitutions: Division 01 - Product Requirements.
- B. 1/4 inch NPT or 1/2 inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
1. Neoprene core for temperatures up to 200 degrees F.
- C. Test Kit:
1. Carrying case, internally padded and fitted containing:
 - a. One 2-1/2 inch diameter pressure gages.
 - b. Two gage adapters with 1/8 inch probes.
 - c. Two 1-1/2 inch dial thermometers.

2.6 FLEXIBLE CONNECTORS

- A. Corrugated bronze hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 500 psig.

2.7 DIAPHRAGM-TYPE EXPANSION TANKS

- A. Manufacturers:

1. Amtrol.
 2. Bell & Gossett.
 3. Armstrong.
 4. Substitutions: Division 01 - Product Requirements.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible butyl EPDM diaphragm sealed into tank.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.

2.8 AIR VENTS

- A. Manufacturers:
1. Taco.
 2. Hoffman.
 3. Bell & Gosset.
 4. Substitutions: Division 01 - Product Requirements.
- B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- C. Float Type:
1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
 2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.
- D. Washer Type:
1. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.9 AIR SEPARATORS

- A. Manufacturers:
1. Spirotherm.
 2. Taco.
 3. Substitutions: Division 01 - Product Requirements.

- B. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.
- C. In-line Air Separators: Cast iron for sizes 1-1/2 inch and smaller, or steel for sizes 2 inch and larger; tested and stamped in accordance with ASME Section VIII; for 125 psig operating pressure.

2.10 STRAINERS

- A. Manufacturers:
 - 1. Bell & Gossett.
 - 2. Taco.
 - 3. Armstrong.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Size 2 inch and Smaller:
 - 1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. Size 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel

2.11 BALANCE VALVES

- A. Manufacturers:
 - 1. Bell & Gossett.
 - 2. Taco.
 - 3. Armstrong.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Angle or straight pattern, rising stem, inside screw globe valve for 125 psig working pressure, with bronze body and integral union for screwed connections, renewable composition disc, plastic wheel handle for shut-off service, and lock-shield key cap and set screw memory bonnet for balancing service.

2.12 RELIEF VALVES

- A. Manufacturers:
 - 1. Watts; a Watts Water Technologies, Company.
 - 2. Zurn Industries, LLC.
 - 3. Substitutions: Division 01 - Product Requirements.

- B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

2.13 GLYCOL CHARGING

- A. 17 U.S. gallon HDPE storage/mixing tank with cover; pump suction hose with inlet strainer; pressure pump with fuse protection; low fluid level pump cut-out float switch; manual diverter valve for purging air and agitating contents of storage tank; pressure switch with snubber, adjustable from 10 psig to 25 psig cut-out pressure; integral, liquid-filled pressure gauge; low level pump cut-out. Pressure pump shall be capable of running dry without damage. Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No 68.

2.14 GLYCOL SOLUTION

- A. Manufacturers:
 - 1. Dow Chemical.
 - 2. Substitutions: Division 01 - Product Requirements.
- B. Inhibited propylene glycol and water solution mixed 50 percent glycol - 50 percent water, suitable for operating temperatures from -23 degrees F to 250 degrees F.

PART 3 - EXECUTION

3.1 INSTALLATION - THERMOMETERS AND GAGES

- A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
- B. Install gage taps in piping.
- C. Install pressure gages with pulsation dampers. Provide valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.
- F. Coil and conceal excess capillary on remote element instruments.

- G. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES

- A. Where large air quantities accumulate, provide enlarged air collection standpipes.
- B. Install manual air vents at system high points.
- C. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.
- D. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- E. Provide drain and hose connection with valve on strainer blow down connection.
- F. Provide radiator valves on water inlet for the following terminal heating unit types: radiation, unit heaters, and fan coil units.
- G. Provide radiator-balancing valves on water outlet for the following terminal heating unit types: radiation, unit heaters, and fan coil units.
- H. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- I. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- J. Pipe relief valve outlet to nearest floor drain.
- K. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- L. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Pressure system cold at 5 psig.

3.3 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements and 01 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Test for strength of glycol and water solution and submit written test results.

3.4 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean and flush glycol system before adding glycol solution.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 - Execution and Closeout Requirements: Requirements for protecting installed construction.
- B. Do not install hydronic pressure gauges until after systems are pressure tested.

END OF SECTION

SECTION 23 21 23
HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. VFD Controlled in-line circulators
- B. Related Sections:
 - 1. Section 23 05 03 – Pipes and Tubes for HVAC
 - 2. Section 23 21 16 - Hydronic Piping Specialties

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Underwriters Laboratories Inc.:
 - 1. UL 778 - Motor Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide pumps to operate at system fluid temperatures indicated on Drawings without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.

- C. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALIFICATIONS

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

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

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.
- B. Furnish five year manufacturer warranty for pumps.

1.10 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 - PRODUCTS

2.1 VFD CONTROLLED IN-LINE CIRCULATORS

A. Manufacturers:

1. Grundfos.
2. Substitutions: Division 01 - Product Requirements.

A. The pumps shall be canned rotor type, the pump and motor shall form an integral unit without shaft seal and with only two gaskets for sealing. The bearings shall be lubricated by the pumped liquid.

B. All casings shall be flanged connections.

C. Cast iron or stainless steel pump housing. The pump housing and pump head shall be electrocoated to improve the corrosion resistance. The electrocoating shall include: alkaline cleaning, pretreatment with zinc phosphate coating, cathodic electrocoating and curing of paint film at 392 to 482 Deg F.

1. The pump shall have the following features;
2. Controller integrated in the control box.
3. Control Panel on the Control Box.
4. Control Box prepared for optional control modules.
5. Built in Differential Pressure Temperature and Sensor.
6. Internal motor overload protection.
7. Insulating shells supplied with pumps.
8. Stainless steel bearing plate and rotor cladding.
9. Carbon-fiber-reinforced composite rotor can.

D. The motor and electronic controller shall incorporate a 4-pole synchronous, permanent magnet motor. The pump speed shall be controlled by an integrated frequency controller. A differential pressure sensor shall be incorporated into the pump.

E. Integrated Variable Speed Drive: The VSD shall be designed and manufactured by the same manufacturer as the pump. The VSD shall be factory installed on the motor. The VSD enclosure class shall be IP44. The VSD shall have the human interface options of:

1. Control panel on the VSD face.
2. Building Automation Systems Interface
3. The VSD shall be able controlled by the signals from a single sensor. The acceptable sensors signal is 4 to 20 mA. or 10-10 Vdc signals.
4. VSD shall allow one digital input and one set point input.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings.
- C. Install flexible connectors at or near pumps where piping configuration does not absorb vibration. Refer to Section 23 21 16.
- D. Lubricate pumps before start-up.

3.2 FIELD QUALITY CONTROL

- A. Division 01 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION

SECTION 23 57 00**HEAT EXCHANGERS FOR HVAC****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes brazed plate type heat exchangers, plate type heat exchangers and accessories and trim.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Execution requirements for heat exchanger supports specified by this section.
 - 2. Section 23 07 00 - HVAC Insulation: Field applied insulation for heat exchangers.
 - 3. Section 23 21 16 - Hydronic Piping Specialties: Product requirements for heat exchanger trim for placement by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate dimensions, locations, size of taps, and support frame.
- C. Product Data: Submit performance data.
- D. Test Reports: Indicate shop test reports of tube bundle shop pressure tests.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.

- B. Operation and Maintenance Data: Submit start-up and shut down instructions, assembly drawings, and spare parts lists.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Alaska standards and as amended by the local authority having jurisdiction.

1.6 QUALIFICATIONS

- A. Manufacturer: 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 years documented experience approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept heat exchangers on site in factory protective packaging. Inspect for damage.
- C. Protect openings with temporary caps to prevent entry of foreign material.

1.8 WARRANTY

- A. Division 01- Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five year manufacturer's warranty for heat exchangers

PART 2 - PRODUCTS

2.1 SINGLE WALL BRAZED PLATE HEAT EXCHANGERS

- A. Manufacturers:
 - 1. SWEP
 - 2. Kelvion
 - 3. Taco
 - 4. Substitutions: Division 01 - Product Requirements.

- B. Construction: Braze alloy to be copper 99.9% and connector to be 304 stainless steel.
- C. Plates: Single wall, Stainless steel Type 316L.
- D. Maximum allowable working pressure rating 650 psig and temperature rating 350°F.
- E. Heat Exchanger Performance: See schedule on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Work in accordance with State of Alaska standards and as amended by the local authority having jurisdiction.
- B. Support heat exchangers on welded steel pipe and angle floor stand or as noted on drawings.
- C. Make connections to heat exchangers with unions or flanges.
- D. Install heat exchanger to allow draining and install drain connection at low point.
- E. Pipe in counterflow direction.
- F. Install piping from relief valve to nearest floor drain.
- G. Install heat exchanger with the following piping accessories on hot water piping connections.
 - 1. On supply:
 - a. Thermometer well and thermometer.
 - b. Well for temperature sensor.
 - c. Shutoff valve.
 - d. Strainer.
 - e. Pressure gauge.
 - 2. On return:
 - a. Thermometer well and thermometer.
 - b. Well for temperature sensor.
 - c. Pressure gauge.
 - d. Shutoff valve.
- H. Additionally, install valves and piping specialties in accordance with details as indicated on Drawings.

- I. Support Heat Exchanger per detail in design drawings.

END OF SECTION

DIVISION 26 ELECTRICAL

SECTION 26 00 00
ELECTRICAL WORK GENERAL

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall provide electrical Work, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section apply to all sections in Division 26, except as indicated otherwise.
- C. The Work of this Section is required for operation of electrically-driven equipment provided under specifications in other Divisions and as shown on the plans. The Contractor's attention is directed to the requirement for proper coordination of the Work of this Section with the Work of equipment specifications, and the Work of instrumentation sections.
- D. Concrete, excavation, backfill, and steel reinforcement required for foundation, installation, or construction of the Work of the various sections of Division 26 is included as a part of the Work under the respective sections or as required.

1.2 REFERENCE STANDARDS

- A. The Work of this Section and all sections in Division 26 shall comply with the latest adopted versions of the following, as applicable:

NEC (NFPA 70)	National Electrical Code as amended by the State of Alaska
NETA	International Electrical Testing Association
NEMA 250	Enclosure for Electrical Equipment (1000 Volts Maximum)
NECA 1	Standard for Good Workmanship in Electrical Construction
- B. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL).
- C. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards, state building standards, and applicable local codes and regulations.
- D. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 CONTRACT DRAWINGS

- A. The electrical drawings are diagrammatic and are not intended to show all raceway, wiring, exact locations of equipment, terminations, or number or types of fittings required by the electrical system. Provide all related electrical work which is specified herein, diagrammed or scheduled on the electrical drawings, required by code enforcing agencies and as indicated on other details or elevations for complete and operating electrical systems. Since the plan drawings of floor, wall, and ceiling installation are made at a small scale, outlets, devices, equipment, etc. are indicated only in their approximate location unless dimensioned or otherwise indicated. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned and coordinate such locations with the work of other trades to prevent interferences. Verify all dimensions on the job.
- B. Existing information shown on drawings was obtained from record drawings and limited field observations. Field verify actual conditions and report any discrepancies to the Engineer for resolution before beginning work.
- C. The electrical drawings and specifications are complementary, and the requirements of one shall be binding as if called for by both. Items shown on the drawings are not necessarily included in the specifications. All directives and instructions in the drawings and specifications shall be interpreted as directives to the Contractor unless clearly specified otherwise. If conflict should occur between the drawings and specifications, the more stringent requirement shall apply. Any discrepancies in the construction documents shall immediately be brought to the attention of the Engineer for resolution.

1.4 PUBLIC UTILITIES REQUIREMENTS

- A. Electric Service
 - 1. The Contractor shall contact the serving utility, Unalakleet Village Electrical Cooperative (UVEC), and verify compliance with their service requirements before construction. The Contractor shall coordinate schedules and payments for Work by all utilities.
 - 2. Electrical service shall be installed as indicated and be as required by the serving utility.
 - 3. The Contractor shall verify and provide all service conduits, fittings, grounding devices, and all service wires not provided by the serving utility.
 - 4. The Contractor shall verify with the utility the exact location of each service point and type of service, and shall pay all charges levied by the serving utilities as part of the Work.
 - 5. The Contractor shall pay all connection and turn-on service charges required by the utility company.

1.5 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance Section 01 33 00 – Submittals.
- B. Substitutions shall be in accordance with Section 01 25 13 – Product Options and Substitutions.

- C. Shop Drawings: Include the following:
1. Complete material lists stating manufacturer and brand name of each item or class of material.
 2. Shop Drawings for all grounding Work not specifically indicated.
 3. Front, side, rear elevations, and top views with dimensional data.
 4. Location of conduit entrances and access plates.
 5. Component data.
 6. Connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers.
 7. Method of anchoring, seismic requirements, weight.
 8. Types of materials and finish.
 9. Nameplates.
 10. Temperature limitations, as applicable.
 11. Voltage requirement, phase, and current, as applicable.
 12. Front and rear access requirements.
 13. Test reports.
 14. Grounding requirements.
 15. Catalog cuts of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material. Catalog data sheets shall be stamped to indicate the project name, applicable Section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the Engineer's stamp.
- D. Shop Drawings shall be custom prepared. Drawings or data indicating "optional" or "as required" equipment are not acceptable. Options not proposed shall be crossed out or deleted from Shop Drawings.
- E. Materials and Equipment Schedules: The Contractor shall deliver to the Engineer within 30 days of the commencement date in the Notice to Proceed, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and other such information required to identify the items.
- F. Owner's Manuals: Complete information in accordance with Section 01 77 19 – Closeout Requirements: Operation and Maintenance Data.
- G. Record Drawings: The Contractor shall show invert and top elevations and routing of all duct banks and concealed below-grade electrical installations. Record Drawings shall be prepared, be available to the Engineer, and be submitted in accordance with Section 01 78 39 – Project Record Documents.
- H. Cutover Plan: Prepare and submit a cutover plan for the phased demolition and construction work shown on drawings for review by the Engineer no later than three (3) weeks after having received approved submittals for equipment and materials. The cutover plan shall include the following:
1. Proposed schedule of major equipment deliveries, demolition, construction, testing and startup activities.
 2. Proposed power system outages, and temporary provisions.
 3. Proposed control system outages and cutover sequencing.

1.6 AREA DESIGNATIONS

A. General:

1. Raceway systems and enclosures shall comply with Section 26 05 33 – Electrical Raceway Systems.
2. Electrical Work specifically indicated in sections within any of the Specifications shall comply with those requirements.
3. Installations in hazardous locations shall conform strictly to the requirements of the Class, Group, and Division indicated.
 - a. Wet Wells and enclosed spaces above are Class 1 Division 1 locations.
 - b. Electrical Work in above ground indoor facilities enclosing sewer wet wells shall be NEMA 7 hazardous.
 - c. The areas within 3 feet of doors or other open penetrations shall be classified as NEMA 1, Division 2 locations.
4. Electrical Work in below grade facilities and exterior locations shall be NEMA 4 or 4X in addition to any area classification.
5. Electrical Work in the following areas shall use wiring methods and ratings as follows:
 - a. WTP – NEMA 12 in general except where NEMA 4X is specifically indicated.
 - b. Mechanical Room – NEMA 12 except where NEMA 4X is specifically indicated.
 - c. Chemical Room – NEMA 4X corrosive, non-metallic with seal off fittings at all wall penetrations.
 - d. Utility Building - non-process areas: – NEMA 1 surface mounted
 - e. Generator Module interior – NEMA 12 Surface mounted

1.7 TESTS

- A. The Contractor shall be responsible for factory and field tests required by specifications in Division 26 and by the Engineer or other authorities having jurisdiction. The Contractor shall furnish necessary testing equipment and pay costs of tests, including all replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.
- B. Where test reports are indicated, proof of design test reports for mass-produced equipment shall be submitted with the Shop Drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be approved prior to shipment. Field test reports shall be submitted for review prior to Substantial Completion.
- C. Equipment or material which fails a test shall be removed and replaced at no cost to the Owner.

1.8 WARRANTY

- A. Warranty shall be manufacturer's standard or a minimum of one year unless noted otherwise in other Division 26 sections.

PART 2 - PRODUCTS

2.1 GENERAL

- A. ALL assemblies, equipment and materials provided on this project shall be new, and shall be listed and labeled for the intended use, as defined by NFPA 70 Article 100, by a third party Listing Laboratory acceptable to the State of Alaska Department of Labor Mechanical Inspections Division. Examples include U/L, ETL, FM/US, CSA/US. Equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the Work shall be products of the same manufacturer. Equipment and materials shall be of industrial grade standard of construction.
- B. Where a NEMA enclosure type is indicated in a non-hazardous location, the Contractor shall utilize that type of enclosure, despite the fact that certain modifications, such as cutouts for control devices, may negate the NEMA rating.
- C. Control Panels & Terminal Boxes: Comply with NEC Article 409 and UL standards. Provide shop drawings for shop assemblies with bill of material acceptable to the Authority Having Jurisdiction (AHJ).
- D. Corrosion Protection: All metallic materials in electrical work shall be protected against corrosion. For metallic materials in harsh indoor environments and all outdoor installation, provide stainless steel or a high-performance corrosion resistant coating suitable for the environment, with stainless steel fasteners and operating hardware.

PART 3 - EXECUTION

3.1 GENERAL

- A. Incidentals: The Contractor shall provide all materials and incidentals required for a complete and operable system, even if not required explicitly by the Specifications or the Drawings. Typical incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor-furnished equipment to connect with other equipment indicated in the Contract Documents.
- B. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined by the Contractor in the field, based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations on the Drawings, however, shall be followed as closely as possible.
 - 1. Where raceway development drawings, or "home runs," are shown, the Contractor shall route the raceways in accordance with the indicated installation requirements. Routings shall be exposed.
 - 2. Conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve headroom and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located as indicated. Where the

Drawings do not indicate exact locations, the Engineer shall determine such locations. If equipment is installed without instruction and shall be moved, it shall be moved without additional cost to the Owner. New lighting fixture locations shall be adjusted slightly to avoid obstructions and to minimize shadows.

3. Wherever raceways and wiring for lighting and receptacles are not indicated, it shall be the Contractor's responsibility to provide all lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations as indicated. Wiring shall be #12 AWG minimum, and conduits shall be 3/4-inch minimum unless otherwise noted. Where circuits are combined in the field in the same raceway, the Contractor shall de-rate conductor ampacities in accordance with NEC requirements.
- C. Workmanship: Materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the work. Installation shall be coordinated in the field with other trades to avoid interferences. Comply with NECA 1 standard as a minimum.
 - D. Protection of Equipment and Materials: The Contractor shall fully protect materials and equipment against damage from any cause. Materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry. The Contractor shall replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections, as part of the Work.
 - E. Incoming utility power equipment shall be provided in conformance with the utility's requirements.
 - F. Conduit and chase penetrations:
 1. Exterior penetrations shall be provided with non-hardening duct sealant to mitigate frost and condensation.
 2. All penetrations shall be provided in a manner that maintains gastight or vapor tight conditions that may exist or are required for the structure.

3.2 SAFETY AND PROTECTION

- A. Safety Measures To Be Taken: The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to the means, methods, techniques, sequences or procedures required for the Contractor to perform his work. The Contractor will be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. It shall be the Contractor's responsibility to comply with applicable safety and health regulations for construction. The Contractor shall consult with the state or federal safety inspector for interpretation whenever in doubt as to whether safe conditions do or do not exist or whether he is or is not in compliance with state or federal regulations.
- B. Protection: The Contractor shall take whatever measures are required to ensure that electrical safety and protection are maintained, including the proper covering, signage, and securing of "live" circuits.

3.3 CONCRETE HOUSEKEEPING PADS

- A. Concrete housekeeping pads and foundations shall be provided for floor standing electrical equipment. Housekeeping pads for equipment, including future units, shall be 3-1/2 inches above surrounding finished floor or grade, and 2 inches larger in both dimensions than the equipment, unless otherwise indicated.
- B. Generator pad shall be as required by the manufacturer unless shown on the plans

3.4 SIGNAGE

- A. Local Disconnect Switches:
 - 1. Each local disconnect switch for motors and equipment shall be legibly marked to indicate its purpose, unless the purpose is unambiguously indicated by the location and arrangement.
- B. Warning Signs:
 - 1. 600 volts nominal, or less. – Entrances to rooms and other guarded locations that contain live parts shall be marked with conspicuous signs prohibiting entry by unqualified persons.
- C. Isolating Switches: Isolating switches not interlocked with an approved circuit interrupting device shall be provided with a sign warning against opening them under load.

3.5 CLEANING

- A. Before final acceptance, the electrical Work shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. Oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners cleaned out. Touch-up paint shall be applied to scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum-cleaned.
- B. Contractor shall group, coil, and tie wrap all spare cables at the bottom of the Local Control Panels. The wires shall be grouped according to the device, control panel, or MCC section they originate from. Cable groups shall be tagged according to their point of origin.
- C. All debris shall be removed from the void below the panels.

3.6 CONTROL PANEL WIRING

- A. The Contractor shall ensure all panels are listed as an assembly upon completion of the Work.

END OF SECTION

SECTION 26 05 00**COMMON WORK RESULTS FOR ELECTRICAL****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes firestopping and existing conditions.

1.2 SYSTEM DESCRIPTION

- A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.
- B. Existing Conditions:
 - 1. Preserve fire resistance, finishes, and the environmental, structural, vapor barrier, and thermal insulation ratings of existing construction in performance of the Work.
 - 2. Comply with Section 02 41 26 – Selective Electrical Demolition.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog data for materials used for firestopping, sealants, insulation, vapor barrier, structural repair, coatings, and related products as required by the Work for penetrations or repairs.

PART 2 - PRODUCTS**2.1 FIRESTOPPING MATERIALS**

- A. Product Description: Listed firestopping assemblies, caulking, sleeves, and intumescent foam.

PART 3 - EXECUTION**3.1 GENERAL**

- A. Comply with Section 02 41 26 – Selective Electrical Demolition.

- B. Comply with NFPA 70 – National Electrical Code.
- C. Comply with NFPA 70E - Standard for Electrical Safety in the Workplace.

3.2 INSTALLATION

- A. Provide selective demolition and salvage as indicated on Drawings.
- B. Examine existing panelboards and other electrical items indicated on Drawings to be reused or re-purposed, to verify suitable condition.
- C. Use only approved materials for repairs and refinishing of existing work that requires repair or modification as a result of demolition and construction work. Repair existing work as required to equal the existing finishes and maintain the environmental, structural, vapor barrier, thermal insulation, and fire resistance ratings.

3.3 FIRESTOPPING

- A. Provide methods and materials that will qualify for a 2-hour rating on all walls enclosing the mechanical room, City Garage and Fire Station.

END OF SECTION

SECTION 26 05 03
EQUIPMENT WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes electrical connections to equipment.
- B. Related Sections:
 - 1. Section 26 05 19 - Electrical Power Conductors and Cables.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittals: Submittal procedures.
- B. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 77 19 - Closeout Requirements: Submittal procedures.
- B. Section 01 78 39 - Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.5 COORDINATION

- A. Section 01 31 19 – Project Meetings.
- B. Obtain and review shop drawings, product data, manufacturer’s wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- E. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORD AND PLUGS

- A. Manufacturers:
 - 1. Leviton Manufacturing Co., Inc.
 - 2. Pass & Seymour/Legrand (Pass & Seymour).
 - 3. Square D; by Schneider Electric.
 - 4. Hubbell / Kellems Inc.
 - 5. Substitutions: Section 01 25 13.
- B. Attachment Plug Construction: Conform to NEMA WD 1.
- C. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.
- D. Cord Construction: Type SOWA multiconductor flexible cords with identified equipment grounding conductor, suitable for use in Arctic locations.
- E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 EXISTING WORK

- A. Remove exposed abandoned equipment wiring connections including abandoned connections above accessible ceiling finishes.
- B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.
- C. Extend existing equipment connections using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

- A. Make electrical connections.
- B. Make conduit connections to equipment subject to vibration or movement using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Install receptacle outlet to accommodate connection with attachment plug.
- E. Install cord and cap for field-supplied attachment plug.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

3.4 ADJUSTING

- A. Section 01 77 19 - Closeout Requirements: Testing, adjusting, and balancing.
- B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION

SECTION 26 05 19**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes building wire and cable; service entrance cable; and wiring connectors and connections.
- B. Related Sections:
 - 1. Section 26 05 53 - Identification for Electrical Systems: Product requirements for wire identification.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Solid or Stranded conductor for feeders and branch circuits 10 AWG and smaller.
 - 2. Stranded conductors for control circuits.
 - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 4. Conductor not smaller than 16 AWG for control circuits.
 - 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.

2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
4. Wet or Damp Interior Locations: Use only building wire, Type XHHW-2 insulation, in raceway.
5. Exterior Locations: Use only building wire, Type XHHW-2 insulation, in raceway, except where overhead cable is expressly defined.
6. Underground Locations: Use only building wire, Type XHHW-2 insulation, in raceway.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittals: Requirements for submittals.
- B. Product Data: Submit for building wire and each cable assembly type.
- C. Design Data: Indicate voltage drop and ampacity calculations for copper conductors.
- D. Test Reports: Indicate procedures and values obtained.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 19 - Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and circuits.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NEC.

1.7 QUALIFICATIONS

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

1.8 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

1.9 COORDINATION

- A. Section 01 31 19 Project Meetings
- B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- C. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Aetna Insulated Wire, Inc.
 - 2. General Cable; General Cable Corporation.
 - 3. Southwire Company.
- B. Substitutions: Section 01 25 13 – Product Options and Substitutions
- C. Product Description: Single conductor insulated wire.
- D. Conductor: Copper.
- E. Insulation Voltage Rating: 600 volts.
- F. Insulation Temperature Rating: 90 degrees C.
- G. Insulation THHN/THHW, XHHW-2

2.2 WIRING CONNECTORS

- A. Manufacturers; Split Bolt Connectors:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ILSCO.
 - 3. Thomas & Betts Corporation; a member of the ABB Group.
 - 4. Substitutions: Section 01 25 13 – Product Options and Substitutions
- B. Manufacturers; Solderless Pressure Connectors:
 - 1. Burndy; Part of Hubbell Electrical Systems.

2. ILSCO.
 3. Thomas & Betts Corporation; a member of the ABB Group.
 4. Substitutions: Section 01 25 13 – Product Options and Substitutions
- C. Manufacturers; Spring Wire Connectors:
1. 3M.
 2. NELCO, Inc.
 3. Substitutions: Section 01 25 13 – Product Options and Substitutions
- D. Manufacturers; Compression Connectors:
1. 3M.
 2. NELCO, Inc.
 3. Substitutions: Section 01 25 13 – Product Options and Substitutions

2.3 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

- A. Remove abandoned wire and cable. Patch surfaces where removed cables pass through building finishes.

- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified, whichever is more stringent or when required to meet code.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques - Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
- F. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

- G. Install stranded conductors for branch circuits 10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.
- H. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- I. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
- J. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.5 WIRE COLOR

- A. General:
 - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Black and red for single phase circuits at 120/240 volts. White Neutral
 - b. Black Orange and Red for three phase 120/240 Volts, Orange depicts "wild" leg. White Neutral.
 - c. Black, red, and blue for circuits at 120/208 volts single or three phase. Gray for Neutral.
 - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Black and red for single phase circuits at 120/240 volts. White Neutral
 - b. Black Orange and Red for three phase 120/240 Volts, Orange depicts "wild" leg. White Neutral.
 - c. Black, red, and blue for circuits at 120/208 volts single or three phase. Gray for Neutral.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number. White or Gray where there are two separate voltage systems. Add alternating stripe if three of four systems present. Intent is to provide unique neutral for each.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:

1. For 6 AWG and smaller: Green.
2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.6 FIELD QUALITY CONTROL

- A. Section 01 45 00 - Quality Control, and Section 01 77 19 - Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

SECTION 26 05 26**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Rod electrodes.
 2. Wire.
 3. Grounding well components.
 4. Mechanical connectors.
 5. Exothermic connections.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
1. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
1. Existing Grounding System
 2. Metal building frame.
 3. Concrete-encased electrode.
 4. Ground ring.
 5. Rod electrode.

1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms maximum.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittals: Requirements for submittals.
- B. Product Data: Submit data on grounding electrodes and connections.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 77 19 - Closeout Requirements: Requirements for submittals.
- B. Section 01 78 39 - Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- B. Perform Work in accordance with NEC.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 13 – Material and Equipment: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.9 COORDINATION

- A. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. ERICO International Corporation.
 - 2. Harger Lightning & Grounding.
 - 3. Substitutions: Section 01 25 13 – Product Options and Substitutions.
- B. Product Description:
 - 1. Material: Copper-clad steel.
 - 2. Diameter: 3/4 inch.
 - 3. Length: 10 feet.
- C. Connector: Connector for exothermic welded connection.

2.2 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: 4 AWG.
- C. Grounding Electrode Conductor: Copper conductor insulated.
- D. Bonding Conductor: Copper conductor insulated.

2.3 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. ILSCO
 - 4. Substitutions: Section 01 25 13 – Product Options and Substitutions.
- B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. ILSCO
 - 4. Substitutions: Section 01 25 13 – Product Options and Substitutions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods as specified.

3.4 INSTALLATION

- A. Install in accordance with IEEE 142 for power and IEEE 1100 for instrumentation.
- B. Install rod electrodes at locations as indicated on Drawings. Install one additional rod electrode to achieve specified resistance to ground and contact engineer if grounding requirement is still not met.
- C. Install grounding and bonding conductors concealed from view.
- D. Install 4 AWG bare copper wire in foundation footing.
- E. Bond together metal siding not attached to grounded structure; bond to ground.

- F. Bond together each metallic raceway, pipe, duct and other metal object entering non-metallic enclosures.
- G. Where shown, install isolated grounding conductor for circuits supplying Instrumentation in accordance with IEEE 1100.
- H. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- I. Connect to site grounding system.
- J. Install continuous grounding by means of driven rods.
- K. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- L. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
- M. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.
- N. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
- O. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.5 FIELD QUALITY CONTROL

- A. Section 01 77 19 - Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

- D. Perform ground resistance testing in accordance with IEEE 142.
- E. Perform leakage current tests in accordance with NFPA 99.
- F. Perform continuity testing in accordance with IEEE 142.
- G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

SECTION 26 05 29**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.

1.2 REFERENCES**A. ASTM International:**

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
4. UL - Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittals: Requirements for submittals.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data:
 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
- D. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- E. Manufacturer's Installation Instructions:
 1. Hangers and Supports: Submit special procedures and assembly of components.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 13 – Materials and Equipment: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2 - PRODUCTS

2.1 MOUNTING HARDWARE

- A. Miscellaneous Hardware:

1. Nuts, bolts, and washers shall be stainless steel.
- B. Strut for mounting of raceways and equipment shall be galvanized or stainless steel as required by the area classification. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion. Strut shall be as manufactured by Unistrut, B-Line, or equal.
- C. Anchors for attaching equipment to concrete walls, floors and ceilings shall be stainless steel expansion anchors, such as "Rawl-Bolt," "Rawl-Stud" or "Lok-Bolt" as manufactured by Rawl; similar by Star, or equal. Wood plugs shall not be permitted.

2.2 CONDUIT SUPPORTS

- A. Manufacturers:
 1. Adalet.
 2. Carlon Electrical Products.
 3. ERICO International Corporation.
 4. Minerallac Company.
 5. MIRO Industries, Inc.
 6. Thomas & Betts Corporation; a member of the ABB Group.
 7. Unistrut; an Atkore International company.

2.3 FORMED STEEL CHANNEL

- A. Manufacturers:
 1. Carlon Electrical Products.
 2. ERICO International Corporation.
 3. Thomas & Betts Corporation; a member of the ABB Group.
 4. Unistrut; an Atkore International company.

PART 3 - EXECUTION

3.1 EQUIPMENT ANCHORING

- A. Floor supported, wall-, or ceiling-hung equipment and conductors shall be anchored in place by methods that will meet seismic requirements in the area where the project is located. Wall-mounted panels that weigh more than 500 pounds, or which are within 18 inches of the floor, shall be provided with fabricated steel support pedestals. If the supported equipment is a panel or cabinet enclosed within removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung from 4-inch stud walls and weighing more than 300 pounds shall have auxiliary floor supports.

- B. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the Work of this Contract.
- C. Panels, raceways, and other equipment shall be anchored and supported for Seismic requirements for Zone 1.
- D. Select materials, sizes, and types of anchors, fasteners, and supports to carry loads of equipment and raceway, including weight of wire and cable in raceway. Anchor and fasten electrical products to building elements and finishes as follows:
 - 1. Concrete Structural Elements: Expansion anchors.
 - 2. Steel Structural Elements: Beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
 - 3. Concrete Surfaces: Self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Expansion anchors and preset inserts.
 - 6. Sheet Metal: Sheet metal screws.
 - 7. Wood Elements: Wood screws.

3.2 EXAMINATION

- A. Verify openings are ready to receive sleeves.

3.3 PREPARATION

- A. Obtain permission from Engineer before using powder-actuated anchors.
- B. Do not drill or cut structural members.

3.4 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Provide fastening equipment constructed using stainless or galvanized steel.
 - 2. Concrete Structural Elements: Provide, expansion anchors, powder actuated anchors.
 - 3. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
 - 4. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - 5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 - 6. Solid Masonry Walls: Provide expansion anchors and preset inserts.
 - 7. Sheet Metal: Provide sheet metal screws.
 - 8. Wood Elements: Provide wood screws.

- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below (where accessible) and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- B. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 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 at both sides of penetration.

3.7 FIELD QUALITY CONTROL

- A. Section 01 77 19 - Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

3.8 CLEANING

- A. Section 01 77 19 - Closeout Requirements: Requirements for cleaning.

3.9 PROTECTION OF FINISHED WORK

- A. Div 01: Requirements for Temporary Controls Contractor Furnished Items.
- B. Protect finished work and adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 26 05 33**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
 - 1. Section 26 05 03 - Equipment Wiring Connections.
 - 2. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 3. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 4. Section 26 05 53 - Identification for Electrical Systems.
 - 5. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations as required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway and boxes to complete wiring system.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: $\frac{3}{4}$ " inch unless otherwise specified.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittals: Submittal procedures.
- B. Product Data: Submit for the following:
 - 1. Flexible metal conduit.
 - 2. Liquidtight flexible metal conduit.
 - 3. Raceway fittings.
 - 4. Conduit bodies.
 - 5. Wireway.
 - 6. Pull and junction boxes.
 - 7. Handholes.
 - 8. Galvanized rigid conduit
 - 9. Intermediate metal conduit
 - 10. Electrical metallic tubing
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 77 19 - Closeout Requirements: Closeout procedures.
- B. Project Record Documents:
 - 1. Record actual routing of underground and concealed conduits.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 13 – Material and Equipment: Product storage and handling requirements.

- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.8 COORDINATION

- A. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- B. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Allied Tube & Conduit.
 - 2. EGS/Appleton Electric.
 - 3. Republic Conduit.
 - 4. Thomas & Betts Corporation; a member of the ABB Group.
 - 5. Western Tube and Conduit Corporation.
 - 6. Wheatland Tube Company.
 - 7. Substitutions: Section 01 25 13 - Product Options and Substitutions.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 PVC COATED METAL CONDUIT

- A. Manufacturers:
 - 1. Robroy Industries.
 - 2. Thomas & Betts Corporation; a member of the ABB Group.
 - 3. Substitutions: Section 01 25 13 - Product Options and Substitutions.
- B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.

- C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Southwire Company.
 - 4. Substitutions: Section 01 25 13 - Product Options and Substitutions.
- B. Product Description: Interlocked aluminum construction.
- C. Fittings: NEMA FB 1.
 - 1. Insulated throat Connectors

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Anamet Electrical, Inc.
 - 2. Carlon Electrical Products.
 - 3. EGS/Appleton Electric.
 - 4. Southwire Company
 - 5. Substitutions: Section 01 25 13 - Product Options and Substitutions.
- B. Product Description: Interlocked aluminum construction with PVC jacket.
- C. Fittings: NEMA FB 1.
 - 1. Insulated throat connectors

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Emerson Process Management.
 - 3. Republic Conduit.
 - 4. Western Tube and Conduit Corporation.
 - 5. Wheatland Tube Company.
 - 6. Substitutions: Section 01 25 13 - Product Options and Substitutions.

- B. Product Description: ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression type.
 - 1. Insulated throat connectors.
- D. Set screw or indenter type fittings and conduit bodies not permitted.**

2.6 NONMETALLIC CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. EGS/Appleton Electric.
 - 3. Hubbell Premise Wiring.
 - 4. Substitutions: Section 01 25 13 - Product Options and Substitutions.
- B. Product Description: NEMA TC 2; Schedule 40 or 80 PVC as indicated on plans. If not indicated than SCH 80 is to be used.
- C. Fittings and Conduit Bodies: NEMA TC 3.

2.7 WIREWAY

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 3. Hammond Mfg. Co. Inc.
 - 4. Hoffman; a brand of Pentair Equipment Protection.
 - 5. Panduit Corp.
 - 6. Square D; by Schneider Electric.
 - 7. Wiremold / Legrand.
 - 8. Substitutions: Section 01 25 13 - Product Options and Substitutions.
- B. Product Description: Oiltight and dust-tight type wireway.
- C. Knockouts: Manufacturer's standard.
- D. Size and length as indicated on Drawings. If not shown, provide 6x6 wireway, length as required.
- E. Cover: Hinged cover with full gaskets.
- F. Connector: Flanged.

- G. Fittings: Lay-in type with removable top, bottom, and side; captive screws.
- H. Finish: Rust inhibiting primer coating with gray enamel finish.

2.8 OUTLET BOXES

- A. Manufacturers:
 - 1. Allied Moulded Products, Inc.
 - 2. Carlon Electrical Products.
 - 3. Emerson Electric Co.
 - 4. RACO; Hubbell.
 - 5. Substitutions: Section 01 25 13 - Product Options and Substitutions.
- B. Nonmetallic Outlet Boxes: NEMA OS 2.
- C. Sheet Steel Boxes
- D. Cast Boxes: NEMA FB 1, Type FD, cast ferrous alloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- E. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- F. Wall Plates for Unfinished Areas and Surface mounted raceway: Furnish gasketed cover.

2.9 PULL AND JUNCTION BOXES

- A. Manufacturers:
 - 1. Emerson Process Management.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. Kraloy.
 - 4. RACO; Hubbell.
 - 5. Substitutions: Section 01 25 13 - Product Options and Substitutions.
- B. Hinged Enclosures: As specified in Section 26 27 16.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Underground More than 5 feet outside Foundation Wall: Provide bituminous wrapped galvanized rigid conduit. Provide cast metal boxes or nonmetallic handhole.
- F. Underground Within 5 feet from Foundation Wall: Provide bituminous wrapped galvanized rigid conduit. Provide cast metal or nonmetallic boxes.
- G. In or Under Slab on Grade: Provide rigid steel conduit, intermediate metal conduit. Provide cast or metal boxes.

- H. Outdoor Locations, Above Grade: Provide Plastic coated galvanized rigid conduit. Provide plastic coated cast metal outlet, pull, and junction boxes.
- I. In Slab Above Grade: Provide rigid steel conduit, intermediate metal conduit. Provide cast boxes.
- J. Wet and Damp Locations: Provide rigid steel conduit, intermediate metal conduit, electrical metallic tubing. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- K. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes with access. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- L. Exposed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide hinged enclosure for large pull boxes.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maintain clearance between raceway and piping for maintenance purposes.

- L. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- M. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- N. Bring conduit to shoulder of fittings; fasten securely.
- O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- P. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes without hubs.
- Q. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.
- R. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- S. Install fittings to accommodate expansion and deflection where raceway crosses, control and expansion joints.
- T. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- U. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- V. Close ends and unused openings in wireway.
- W. Duct seal interior of conduits where they pass from exterior to interior.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings (notes or elevations) unless specified in section for outlet device.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

- F. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- G. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- H. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- J. Install adjustable steel channel fasteners for hung ceiling outlet box.
- K. Do not fasten boxes to ceiling support wires or other piping systems.
- L. Support boxes independently of conduit.
- M. Install gang box where more than one device is mounted together. Do not use sectional box.
- N. Install gang box with plaster ring for single device outlets.

3.6 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 CORE DRILLING

- A. The Contractor shall perform core drilling required for installation of raceways through concrete walls and floors if required. Locations of floor penetrations, as may be required, shall be based on field conditions. Verify all exact core drilling locations based on equipment actually furnished, as well as exact field placement. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the Owner prior to any core drilling activities. Damage to any encased conduits, wiring, and piping shall be repaired as part of the Work.
- B. All penetrations required to extend raceways through concrete walls, roofs, and floors or masonry walls shall be core drilled.

3.8 ADJUSTING

- A. Section 01 77 19 - Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.9 CLEANING

- A. Section 01 77 19 - Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 53**IDENTIFICATION FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittals: Submittal procedures.
- 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.
- C. Samples:
 - 1. Submit two samples of each type of identification products applicable to project.
 - 2. Submit two nameplates, 4 x 4 inch in size illustrating materials and engraving quality.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 77 19 - Closeout Requirements: Requirements for submittals.
- B. Section 01 78 39 - Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with NEC.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 13 – Material and Equipment: Requirements for transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 13 – Material and Equipment: Environmental conditions affecting products on site.
- B. Install labels or nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 PRODUCTS

2.1 ELECTRICAL IDENTIFICATION

- A. Nameplates: Nameplates shall be fabricated from black-letter, white-face laminated plastic lamacoid, engraving stock, Formica type ES-1, or equal. Each shall be fastened securely, using fasteners of brass, cadmium-plated steel, or stainless steel, screwed into inserts or tapped holes, as required by area classification. Engraved characters shall be block style, with no characters smaller than 1/8-inch in height.
- B. Conductor and Equipment Identification: Conductor identification devices shall be heat-shrink plastic tubing with machine printing. Equipment / Component identification devices shall be permanent and visible without moving wiring or other components to read. Lettering shall read from left to right and shall face toward the front of the panel.

2.2 NAMEPLATES

- A. Manufacturers:
 - 1. Craftmark Pipe Markers.
 - 2. Kolbi Pipe Marker Co.
 - 3. Pipemarket.com; Brimar Industries, Inc.
 - 4. Seton Identification Products.
 - 5. Substitutions: Section 01 25 13 – Product Options and Substitution.
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

- C. Letter Size:
 - 1. 1/8 inch high letters for identifying individual equipment and loads.
 - 2. 1/4 inch high letters for identifying grouped equipment and loads.
 - 3. 3/8 inch high letters for identifying control panels and panelboards.
- D. Minimum nameplate thickness: 1/8 inch.

2.3 WIRE MARKERS

- A. Manufacturers:
 - 1. Brady ID.
 - 2. Grafoplast Wire Markers.
 - 3. Ideal Industries, Inc.
 - 4. 3M Skotchcode.
 - 5. Substitutions: Section 01 25 13 – Product Options and Substitution.
- B. Description: Cloth tape, split sleeve, or tubing type wire markers, with circuit or control wire number permanently stamped or printed.
- C. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
 - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams shop drawings.

2.4 CONDUIT AND RACEWAY MARKERS

- A. Manufacturers:
 - 1. Brady ID.
 - 2. Ideal Industries, Inc.
 - 3. Seton Identification Products.
 - 4. Substitutions: Section 01 25 13 – Product Options and Substitution.
- B. Description: Nameplate fastened with straps Labels fastened with adhesive.
- C. Color:
 - 1. 240 Volt System: Black lettering on white background.
 - 2. 208 Volt System: Black lettering on white background.
- D. Legend:
 - 1. 208 Volt System: 208 VOLTS.
 - 2. 240 System: 240 VOLTS.
 - 3. Controls: DATA/CONTROL
- E. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches Outside Diameter of Raceway: 1/2 inch high letters.
 - 2. 2-1/2 to 6 inches Outside Diameter of Raceway: 1 inch high letters.

2.5 LOCKOUT DEVICES

- A. Lockout Hasps:
 - 1. Manufacturers:
 - a. Brady ID.
 - b. Master Lock Company, LLC.
 - c. Substitutions: Section 01 25 13 – Product Options and Substitution.
 - 2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

PART 3 EXECUTION

3.1 EQUIPMENT IDENTIFICATION

- A. General: Equipment and devices shall be identified as follows:
 - 1. Nameplates shall be provided for all panelboards, control and instrumentation panels, starters, switches, and pushbutton stations. In addition to nameplates, control devices shall be equipped with standard collar-type legend plates.
 - 2. Control devices within enclosures shall be identified as indicated. Identification shall be similar to the subparagraph above.
 - 3. Equipment names and tag numbers, where indicated on the Drawings, shall be utilized on all nameplates.
 - 4. The Contractor shall furnish typewritten circuit directories for panelboards; circuit directory shall accurately reflect the equipment connected to each circuit.
 - 5. Generator receptacles shall be identified with the incoming service voltage with 1” lettering.
 - 6. Generator transfer switches shall be labeled “Main” and “Generator” with ½” lettering.

3.2 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.3 EXISTING WORK

- A. Install identification on existing equipment to remain in accordance with this section.
- B. Install identification on unmarked existing equipment.
- C. Replace lost nameplates.
- D. Re-stencil existing equipment.

3.4 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.

2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners or adhesive.
 4. Secure nameplate to equipment front using screws or adhesive.
 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 6. Install nameplates for the following:
 - a. Switchboards.
 - b. Panelboards.
 - c. Transformers.
 - d. Service Disconnects.
 - e. Control Panels.
 - f. Disconnects
- C. Label Installation:
1. Install label parallel to equipment lines.
 2. Install label for identification of individual control device stations, and disconnects.
 3. Install labels for permanent adhesion and seal with clear lacquer.
- D. Wire Marker Installation:
1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes each load connection.
 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
 3. Install labels at data outlets identifying panel and termination designation per approved shop drawings or as indicated on Drawings.
- E. Conduit Marker Installation:
1. Install conduit marker for each conduit longer than 6 feet.
 2. Conduit Marker Spacing: 20 feet on center.

END OF SECTION

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL AND CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The requirements of this section apply to all sections of Divisions 26 and 40.
- B. Commission the Process and Control systems that are modified, replaced, or added to the existing water treatment plant facilities.
- C. Commission the Plumbing, Mechanical, and Electrical systems that support the Process and Control systems. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 Commissioning:
 - 1. Electrical and Control System commissioning description.
 - 2. Electrical and Control System commissioning responsibilities.
- D. Related Sections:
 - 1. Division 22, 23, 26 and 40 Specifications

1.2 REFERENCES

- A. National Electrical Testing Agency.

1.3 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Divisions 22, 23, 26 and 40 is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 is required.
- B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:
- C. Electrical and Controls Systems commissioning process includes the following tasks:
 - 1. Testing and startup of Electrical and Control equipment and systems.
 - 2. Equipment and system verification checks.
 - 3. Assistance in functional performance testing to verify testing and equipment and system performance.
 - 4. Provide qualified personnel to assist in commissioning tests.

5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
9. Provide training for systems specified in this Section with coordination by Commissioning Authority.

D. Equipment and Systems to Be Commissioned:

1. New Electrical and Control systems that were installed under this Contract.
2. Existing Electrical and Control systems that were modified, adjusted, upgraded, or affected by the Work performed under this Contract.

E. The following is a partial list of equipment that may be included in this Commissioning:

1. All new and existing panels re-served under this contract
2. Instrumentation and Bypass Control Panel.
3. All instrumentation and valves related to Heat Recovery and Bypass Controls.
4. Transfer Switch
5. All instrumentation and valves related to Bypass Controls.
6. Lift Station Power Supply
7. Generator
8. All existing and new motors and circuits operating as intended.

1.4 COMMISSIONING SUBMITTALS

- A. Section 01 91 00 - Commissioning: Requirements for commissioning submittals.
- B. Draft Forms: Submit draft of system verification form and functional performance test checklist.
- C. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified.
- D. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.

- C. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NETA requirements.
- B. Maintain one copy of each document on site.

1.7 COMMISSIONING RESPONSIBILITIES

- A. Equipment or System Installer Commissioning Responsibilities:
 - 1. Attend commissioning meetings.
 - 2. Ensure controls installer performs assigned commissioning responsibilities as specified below.
 - 3. Ensure calibration agency performs assigned commissioning responsibilities as specified.
 - 4. Provide instructions and demonstrations for Owner's personnel.
 - 5. Ensure subcontractors perform assigned commissioning responsibilities.
 - 6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
 - 7. Develop startup and initial checkout plan using manufacturer's startup procedures and functional performance checklists for equipment and systems to be commissioned.
 - 8. During verification check and startup process, execute process related portions of checklists for equipment and systems to be commissioned.
 - 9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
 - 10. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
 - 11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
 - 12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
 - 13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
 - 14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
 - 15. Provide factory supervised startup services for equipment and systems specified in Division 22, 23, 26 and 40. Coordinate Work with manufacturer and Commissioning Authority.
 - 16. Perform verification checks and startup on equipment and systems as specified.
 - 17. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.

18. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
19. Conduct process system orientation and inspection.

B. Controls Installer Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Review design for ability of systems to be controlled including the following:
 - a. Confirm proper hardware requirements exists to perform functional performance testing.
 - b. Confirm proper safeties and interlocks are included in design.
 - c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
 - d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
 - e. Confirm sensors selected are within device ranges.
 - f. Review sequences of operation and obtain clarification from Architect/Engineer.
 - g. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers' stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.
3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other Electrical and Controls sections.
4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer.
5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan and requirements of Divisions 22, 23, 26 and 40.
7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

C. Testing, Adjusting, and Calibration Agency Commissioning Responsibilities:

1. Attend commissioning meetings.
2. Participate in verification of testing, adjusting, and calibration report for verification or diagnostic purposes.
3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.8 COMMISSIONING MEETINGS

- A. Section 01 91 00 - Commissioning: Requirements for commissioning meetings.
- B. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.9 COORDINATION

- A. Notify Commissioning Authority minimum of four weeks in advance of the following:
 - 1. Scheduled equipment and system startups.
 - 2. Scheduled automatic temperature control system checkout.
 - 3. Scheduled start of testing, adjusting, and calibration work.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 19 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing.
- B. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists.
- C. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 22, 23, 26 and 40 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF OWNER'S PERSONNEL

- A. Training of the operation and maintenance personnel is required. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 26 22 00**LOW-VOLTAGE TRANSFORMERS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Two-winding transformers.
2. Autotransformers.

B. Related Requirements:

1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
3. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
4. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCE STANDARDS**A. National Electrical Manufacturers Association:**

1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
2. NEMA ST 20 - Dry Type Transformers for General Applications.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS**A. Section 01 33 00 – Submittals: Submittal procedures.****B. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise****C. Test and Evaluation Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.****D. Source Quality Control Submittals: Indicate results of factory tests and inspections.**

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

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 77 19 - Closeout Requirements: Closeout procedures.
- B. Section 01 78 39 – Project Record Documents: Record actual locations of transformers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 13 – Material and Equipment: Product storage and handling requirements.
- B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Manufacturers:

1. Eaton Corporation.
2. General Electric Company/GE Prolec.
3. Hammond Power Solutions, Inc.
4. Schneider Electric USA, Inc.
5. Sola/Hevi-Duty; a brand of Emerson Electric Co.
6. Substitutions: Section 01 25 13 – Product Options and Substitutions.

B. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers.

C. Operation:

1. Primary and Secondary Voltage: As indicated on Drawings.
2. Transformer T-2, 30 kVA:
 - a. Primary Voltage: 208Y volts, 3 phase.
 - b. Secondary Voltage: 240 Δ /120 volts, 3 phase, 4 wire, high-leg delta.
3. Insulation system and average winding temperature rise for rated kVA as follows:
 - a. 1-15 kVA: Class 185 with 80 degrees C rise.
 - b. 16-5000 kVA: Class 220 with 115 degrees C rise.

- c. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
4. Winding Taps:
 - a. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - b. Transformers 15 kVA and Larger: NEMA ST 20.
5. Sound Levels: NEMA ST 20.
6. Basic Impulse Level: 10 kV.
7. Mounting:
 - a. 1-15 kVA: Suitable for wall mounting.
 - b. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
 - c. Larger than 75 kVA: Suitable for floor mounting.

D. Materials:

1. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
2. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
3. Enclosure: NEMA ST 20, Type 3R. Furnish lifting eyes or brackets.

E. Fabrication:

1. Isolate core and coil from enclosure using vibration-absorbing mounts.
2. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 AUTOTRANSFORMER

A. Manufacturers:

1. Eaton Corporation.
2. General Electric Company/GE Prolec.
3. Hammond Power Solutions, Inc.
4. Schneider Electric USA, Inc.
5. Sola/Hevi-Duty; a brand of Emerson Electric Co.
6. Substitutions: Section 01 25 13 – Product Options and Substitutions.

B. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers.

C. Operation:

1. Primary and Secondary Voltage: As indicated on Drawings.
2. Transformer AT-1, 75 kVA:
 - a. Primary Voltage: 208 volts, 3 phase.
 - b. Secondary Voltage: 240 volts, 3 phase.
3. Insulation system and average winding temperature rise for rated kVA as follows:

- a. 1-15 kVA: Class 130 with 80 degrees C rise.
- b. 16-500 kVA: Class 200 with 130 degrees C rise.
4. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
5. Winding Taps:
 - a. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - b. Transformers 15 kVA and Larger: NEMA ST 20.
6. Sound Levels: NEMA ST 20.
7. Use three-legged core construction.
8. Mounting:
 - a. 1-15 kVA: Suitable for wall mounting.
 - b. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
 - c. Larger than 75 kVA: Suitable for floor mounting.

D. Materials:

1. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
2. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
3. Enclosure: NEMA ST 20, Type 3R. Furnish lifting eyes or brackets.

E. Fabrication:

1. Isolate core and coil from enclosure using vibration-absorbing mounts.
2. Nameplate: Include transformer connection data.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 45 00 - Quality Control: Testing, inspection and analysis requirements.
- B. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 77 19 - Closeout Requirements: Requirements for installation examination.
- B. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 PREPARATION

- A. Section 01 77 19 - Closeout Requirements: Requirements for installation preparation.
- B. Provide concrete housekeeping pads for transformers under provisions of Section 26 00 00 – Electrical Work General.

3.3 DEMOLITION

- A. Disconnect and remove abandoned transformers.
- B. Maintain access and adequate ventilation to existing transformers and other installations remaining active and requiring access and ventilation. Modify installation or provide access panel or ventilation grilles.

3.4 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, in accordance with Section 26 05 33, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Support transformers in accordance with Section 26 05 29.
 - 1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
 - 2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
 - 3. Mount trapeze-mounted transformers as indicated on Drawings.
- D. Provide seismic restraints.
- E. Install grounding and bonding in accordance with Section 26 05 26.

3.5 FIELD QUALITY CONTROL

- A. Section 01 77 19 - Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.6 ADJUSTING

- A. Section 01 77 19 - Closeout Requirements: Testing, adjusting, and balancing.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

3.7 CLEANING

- A. Section 01 77 19 - Closeout Requirements: Requirements for cleaning.
- B. Clean existing transformers to remain or to be reinstalled.

END OF SECTION

SECTION 26 24 16**PANELBOARDS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Distribution and branch circuit panelboards.
2. Load centers.

B. Related Requirements:

1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
2. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCE STANDARDS**A. Institute of Electrical and Electronics Engineers:**

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.
2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
5. NEMA PB 1 - Panelboards.
6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

- E. Underwriters Laboratories Inc.:
 - 1. UL 50 - Cabinets and Boxes
 - 2. UL 67 - Safety for Panelboards.
 - 3. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - 4. UL 1283 - Electromagnetic Interference Filters.
 - 5. UL 1449 - Transient Voltage Surge Suppressors.
 - 6. UL 1699 - Arc-Fault Circuit Interrupters.

1.3 SUBMITTALS

- A. Section 26 00 00 - Electrical Work General, Section 01 33 00 - Submittals: Submittal procedures.
- B. Product Data: Submit catalog data showing specified features of standard products.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- D. Source Quality control submittals: Indicate results of factory tests and inspections.
- E. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 77 19 - Closeout Requirements: Requirements for submittals.
- B. Section 01 78 39 - Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 77 19 - Closeout Requirements: Requirements for maintenance products.
- B. Extra Stock Materials:
 - 1. Furnish two of each panelboard key. Panelboards keyed alike.

1.6 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years' experience.

PART 2 - PRODUCTS

2.1 PANELBOARDS

A. Manufacturers:

1. Square D
2. General Electric
3. Eaton
4. Substitutions: Section 01 25 13 – Product Options and Substitutions

B. Description: NEMA PB 1, circuit breaker type panelboard.

C. Operation:

1. Service Conditions:
 - a. Temperature: 50-80 degrees F
 - b. Altitude: 100 feet above sea level.
2. Minimum integrated short circuit rating: 25,000 amperes rms symmetrical for MDP, 22,000 amperes rms symmetrical for all other 240 / 208 volt panelboards, or as indicated on Drawings.

D. Materials

1. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
2. Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
3. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.
4. Enclosure: NEMA PB 1, Type 12 minimum or as shown on Drawings.

E. Finishes

1. Manufacturer's standard gray enamel for NEMA 12

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Control: Testing, inspection and analysis requirements.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Disconnect abandoned panelboards. Remove abandoned panelboards.
- B. For existing panelboards scheduled for relocation, as-built existing installation including circuits served, conductors and breaker ampacity. Unless otherwise noted re-serve all existing loads based on as-built conditions.
- C. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.

3.2 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads. Identify each circuit as to its clear, evident and specific purpose of use.
- G. Install engraved plastic nameplates in accordance with Section 26 05 53.
- H. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.3 RESTORATION

- A. Repair existing panelboards to remain or to be reinstalled.

3.4 FIELD QUALITY CONTROL

- A. Section 01 77 19 - Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

3.5 ADJUSTING

- A. Section 01 77 19 - Closeout Requirements: Requirements for starting and adjusting.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 10 percent of each other. Maintain proper phasing for multi-wire branch circuits.

3.6 CLEANING

- A. Section 01 77 19 - Closeout Requirements: Requirements for cleaning.
- B. Clean existing panelboards to remain or to be reinstalled.

END OF SECTION

SECTION 26 27 16
ELECTRICAL CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hinged cover enclosures.
2. Cabinets.
3. Terminal blocks.
4. Accessories.

B. Related Requirements:

1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
3. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittals: Submittal procedures.
- B. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.
- C. Manufacturer's Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:

1. Furnish two of each key.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

A. Manufacturers:

1. Adalet.
2. Carlon Electrical Products.
3. Hoffman; a brand of Pentair Equipment Protection.
4. Leviton Manufacturing Co., Inc.
5. Wiegmann; Hubbell Inc.
6. Substitutions: Section 01 25 13 - Product Options and Substitutions.

B. Description: NEMA 250, Type NEMA 1, 4X, or 12 enclosure, as required by area designation.

1. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.
2. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
3. Enclosure Finish: Manufacturer's standard enamel, ANSI 61 gray.
4. Enclosure Material:
 - a. NEMA 1: Steel.
 - b. NEMA 4X: Stainless steel or non-metallic.
 - c. NEMA 12: Steel.

2.2 CABINETS

A. Manufacturers:

1. Hammond Mfg. Co. Inc.
2. Hoffman; a brand of Pentair Equipment Protection
3. Substitutions: Section 01 25 13 - Product Options and Substitutions.

B. Description:

1. Boxes: Galvanized steel.
2. Box Size: As required.
3. Backboard: Paint matte white.
4. Fronts: Steel, surface type with screw cover front door with concealed hinge, and flush lock.
5. Knockouts: None.

C. Fabrication

1. Furnish metal barriers to form separate compartments wiring of different systems and voltages.
2. Furnish accessory feet for free-standing equipment.

D. Finishes:

1. Finish with gray baked enamel.

2.3 TERMINAL BLOCKS

A. Manufacturers:

1. Allen-Bradley/Rockwell Automation.
2. Cooper Bussmann; a division of Cooper Industries.
3. Square D; by Schneider Electric.
4. Entrelec.
5. Weidmueller.
6. Substitutions: Section 01 25 13 - Product Options and Substitutions.

B. Description:

1. Terminal Blocks: NEMA ICS 4.
2. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
3. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
4. Furnish ground bus terminal block, with each connector bonded to enclosure.

2.4 PLASTIC RACEWAY

A. Manufacturers:

1. Panduit Corp.
2. Wiremold / Legrand.
3. Substitutions: Section 01 25 13 - Product Options and Substitutions.

B. Description: Plastic channel with hinged or snap-on cover.

2.5 CORROSION PROTECTION

A. Manufacturers; Emitter:

1. Cortec Corporation.
 2. Substitutions: Section 01 25 13 - Product Options and Substitutions.
 3. Description: Foam emitter to provide long term protection against corrosion by airborne contaminants.
 - a. For each enclosure, furnish quantity as indicated in manufacturer's instructions to protect the enclosure.
- B. Manufacturers; Absorber:
1. Cortec Corporation.
 2. Substitutions: Section 01 25 13 - Product Options and Substitutions.
 3. Description: Plastic cup with breathable membrane to absorb corrosive gasses from the enclosure.
 - a. For each enclosure, furnish quantity as indicated in manufacturer's instructions to protect the enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Section 26 00 00 Area Designations that identify specific ratings required for designated areas and locations.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 26 05 29.
- C. Install cabinet fronts plumb.

3.2 CLEANING

- A. Section 01 77 19 - Closeout Requirements: Final cleaning.
- B. Clean existing cabinets and enclosures to remain or to be reinstalled.
- C. Clean electrical parts to remove conductive and harmful materials.
- D. Remove dirt and debris from enclosure.
- E. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 28 26**ENCLOSED TRANSFER SWITCHES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes transfer switches in individual enclosures.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 3. Section 26 05 53 - Identification for Electrical Systems.
 - 4. Section 26 32 13 - Engine Generators for testing requirements.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. Underwriters Laboratories Inc.:
 - 1. UL 1008 - Transfer Switch Equipment.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittals: Submittal procedures.
- B. Product Data: Submit catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 77 19 - Closeout Requirements: Closeout procedures.

- B. Project Record Documents: Record actual locations of enclosed transfer switches.
- C. Operation and Maintenance Data: Submit routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Supplier: Authorized distributor of specified manufacturer with minimum three years' experience.

1.6 MAINTENANCE SERVICE

- A. Section 01 77 19 - Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of transfer switches for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MECHANICALLY HELD TRANSFER SWITCH

- A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
- B. The switch shall be positively locked and unaffected by momentary outages. All main contacts shall be silver composition. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors.
- C. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.
- D. Transfer switch shall be suitable for operation on a 4-wire WYE service.
- E. Transfer switch shall include:
 - 1. Solid insulated neutral bus.

2. Equipment ground bus bonded to the enclosure.
- F. Transfer switch rating shall be as shown on the plans and specified herein.

2.2 MICROPROCESSOR CONTROLLER

- A. The controller's sensing and logic shall be provided by a single built-in microprocessor.
- B. A single controller shall provide twelve selectable nominal voltages. Voltage sensing shall be true RMS type and shall be accurate to $\pm 1\%$ of nominal voltage. Frequency sensing shall be accurate to $\pm 0.2\%$. The panel shall be capable of operating over a temperature range of -20 to +60 degrees F and storage from -55 to +85 degrees F. Integral heating shall be furnished for both condensation mitigation and to permit reliable operation in ambient -40F.
- C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit.
- D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
- E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 1. EN 55011:1991 Emission standard - Group 1, Class A
 2. EN 50082-2:1995 Generic immunity standard, from which:
 3. EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity
 4. ENV 50140:1993 Radiated Electro-Magnetic field immunity
 5. EN 61000-4-4:1995 Electrical fast transient (EFT) immunity
 6. EN 61000-4-5:1995 Surge transient immunity
 7. EN 61000-4-6:1996 Conducted Radio-Frequency field immunity
 8. IEEE472 (ANSI C37.90A) Ring Wave Test.

2.3 ENCLOSURE

- A. The ATS shall be furnished with wall mounted, NEMA 12 rated enclosure.

2.4 CONTROLLER DISPLAY AND KEYPAD

- A. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters.

2.5 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

- A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal):

<u>Parameter</u>	<u>Sources</u>	<u>Dropout / Trip</u>	<u>Pickup / Reset</u>
Undervoltage	N&E, 3 ϕ	70 to 98%	85 to 100%
Overvoltage	N&E, 3 ϕ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

- B. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- C. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- D. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

2.6 TIME DELAYS

- A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.
- B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
- C. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
- D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
- E. All time delays shall be adjustable in 1 second increments using the LCD display and keypad.

2.7 ADDITIONAL FEATURES

- A. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set

to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

- B. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
- C. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
- D. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
- E. An in-phase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer.
- F. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
- G. Self-Diagnostics: The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
- H. Data Logging: The controller shall have the ability to log time and date stamped data and to maintain the last 99 events in the event of total power loss, including:
 - 1. Event Logging
 - a. Data and time and reason for transfer normal to emergency.
 - b. Data and time and reason for transfer emergency to normal.
 - c. Data and time and reason for engine start.
 - d. Data and time engine stopped.
 - e. Data and time emergency source available.
 - f. Data and time emergency source not available.
 - 2. Statistical Data
 - a. Total number of transfers.
 - b. Total number of transfers due to source failure.
 - c. Total number of days the controller is energized.
 - d. Total number of hours both normal and emergency sources are available.

2.8 WITHSTAND AND CLOSING RATINGS

- A. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
- B. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings.

2.9 ACCEPTABLE MANUFACTURERS

- A. Automatic transfer switches shall be **ASCO Series 300**, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install engraved plastic nameplates in accordance with Section 26 05 53.

3.2 FIELD QUALITY CONTROL

- A. Section 01 45 00 - Quality Control; 01 77 19 - Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.22.3.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Section 01 45 00 - Quality Control: Manufacturers' field services.
- B. Check out transfer switch connections and operations and place in service.

3.4 ADJUSTING

- A. Section 01 77 19 - Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust control and sensing devices to achieve specified sequence of operation.

3.5 DEMONSTRATION AND TRAINING

- A. Demonstrate operation of transfer switch in normal, and emergency modes.
- B. Provide training concurrently with engine generator training.

END OF SECTION

SECTION 26 32 13**ENGINE GENERATORS****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. Provide a packaged engine generator set for standby power supply in the operation of the Unalakleet Water Treatment facilities. The engine generator package shall include the following features:
 - 1. Diesel engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
 - 4. Sub-base fuel tank, with day tank provisions.
 - 5. Fuel system control and monitoring panel.
 - 6. Outdoor walk-in enclosure.
 - 7. Remote annunciator and remote emergency shutdown switch.
 - 8. Startup and commissioning services
- B. In addition to furnishing the generator, startup services including providing all necessary coolant and lubrication fluids and supplies to make the generator standby system completely operational. Fuel in the form of #2 Diesel will be provided by the Owner for all testing.
- C. This Section includes a pre-fabricated, skid-mounted walk-in arctic duty enclosure to house the generator, distribution equipment, and other electrical equipment as shown on the Drawings.

1.2 SCOPE

- A. Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.
- B. Generator shall be housed in a self-contained walk-in enclosure, arctic duty rated with motor operated louvers and power distribution as shown on the plans.
- C. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.
- D. Provide a complete, integrated assembly set of manufacturer's components that form a completely assembled, pre-fabricated enclosure as shown on the Drawings, ready for

installation on Project Site. Enclosure shall be capable of withstanding structural and other loads as specified herein, thermally induced movement, and exposure to weather without failure or infiltration of water into interior. Include structural framing, roof and wall panels, doors, and accessories complying with requirements indicated.

1.3 CODES AND STANDARDS

- A. Comply with the applicable provisions of the Local Building Codes, and meet all requirements by Underwriters Laboratories (UL) and/or the Factory Manual System.
- B. Provide all wiring in accordance with Article 700 of the NEC and Local Electrical Codes, and other sections of these specifications. All wiring shall be in metallic raceway complying with Section 26 05 33.
- C. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of these standards.
 - 1. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 - 2. NFPA 37 – Standard for the installation and use of Stationary Combustion Engines and Gas Turbines
 - 3. NFPA 110 – Standard for Emergency and Standby Power Systems
 - 4. NFPA 70 – National Electrical Code.
- D. The generator set and supplied accessories shall meet the requirements of the following standards:
 - 1. NEMA MG 1 – Motors and Generators
 - a. Alternator shall comply with the requirements of the current version of this standard as they apply to AC alternators.
 - 2. UL 1236 – Battery Chargers for Charging Engine-Starter Batteries
 - 3. UL 2200 – Stationary Engine Generator Assemblies
 - a. Generator sets shall be UL 2200 listed and labeled.
 - 4. NFPA 110 – Emergency and Standby Power Systems
- E. The control system for the generator set shall comply with the following requirements.
 - 1. IEC 8528-4 - Specification for Controlgear and Switchgear
 - 2. UL508 – Industrial Control Equipment
 - a. The entire control system of the generator set shall be UL508 listed and labeled.
- F. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittals: Submittal procedures.
- B. Submit for approval manufacturer's product data with complete description, dimensions, and diagrams for all equipment. Include the following:
 - 1. Make and model of engine and generator.
 - 2. Makes and models of other major auxiliary equipment, including batteries, charger, vibration isolators, and radiator.
 - 3. Manufacturer-produced dimension drawings of the complete engine-generator set clearly showing entrance points for each of the interconnections required.
 - 4. Manufacturer-published kilowatt output curve and published fuel consumption curve.
 - 5. Unit ventilation and combustion air requirements.
 - 6. Manufacturer-published transient response data of the complete engine-generator set upon 50%, 75%, and 100% block loads at 1.0 pf. Data shall include maximum voltage dips, maximum frequency dips, and recovery time periods.
 - 7. Actual electrical diagrams, including schematic diagrams and interconnection wiring diagrams for all equipment to be supplied.
 - 8. Engine altitude deration curve.
 - 9. Generator motor starting curves showing the voltage dips versus starting kVA.
 - 10. Manufacturer warranty statements.
 - 11. Locations and descriptions of the supplier's parts and service facilities within a 4-hour travel time or 600 mile radius of the job site, including parts inventory and number of qualified generator set service personnel.
- C. Delete all superfluous information from submittal data such as model numbers and options for equipment contained on manufacturer's data sheets but not used on this project.
- D. Generator Enclosure:
 - 1. Product Data – Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for enclosure.
 - 2. Shop Drawings – Include plans, elevations, sections, details, and attachments to other work. Include structural analysis data.

1.5 OWNER'S MANUALS

- A. Section 01 77 19 - Closeout Requirements: Closeout procedures.
- B. Submit Owner's Operation and Maintenance Manuals and other information necessary for the operation and maintenance of the system.
- C. Manufacturer-published service manuals for engine, generator, switchgear, and auxiliary equipment.

1.6 WARRANTY AND SERVICE

- A. Section 01 77 19 - Closeout Requirements: Maintenance service.
- B. Equipment furnished under these specifications shall be guaranteed against defective parts and workmanship under terms of the manufacturer's and the dealer's standard warranty. But, in no event, shall it be for a period of less than two years from date of initial start-up of the system and shall include labor and travel time for necessary repairs at the job site. Running hours shall not be a limiting factor for the system warranty.
- C. The equipment distributor shall offer the Owner an annual service contract at the end of the warranty period. Acceptance or rejection of the service contract will be the Owner's option.

1.7 ENGINE AND GENERATOR MANUFACTURER

- A. The engine and generator shall be the product of one manufacturer who has been regularly engaged in the design and production of generator sets for a minimum of ten years. The unit shall be factory assembled and tested as a unit before shipping.

1.8 ENGINE AND GENERATOR SUPPLIER

- A. The engine-generator supplier shall maintain a local parts and service facility within the State of Alaska. The supplier shall carry sufficient inventory to cover no less than 80% parts service within 24 hours and 95% within 48 hours. The supplier shall have factory-trained service representatives to furnish all installation, test, and start-up supervision necessary for final approval and acceptance as well as perform maintenance and repairs on all components as required.

1.9 POWER RATING

- A. Power rating of the engine-generator set shall be based on operation at rated rpm when equipped with all necessary operating accessories such as air cleaners, lubricating oil pump, jacket water pump, governor, alternating current generator, and exciter regulator. Radiator fan shall be included as necessary operating accessory if used. Rating shall apply at site conditions of 100ft above sea level and 100 °F ambient air temperatures.

1.10 TESTING--MANUFACTURER

- A. The manufacturer and/or local representative shall be responsible for three separate tests, as follows:
 - 1. Design Prototype Tests: Components of the standby system such as the engine/generator set, transfer switch, and accessories shall not be subjected to prototype tests since the

tests are potentially damaging. Rather, similar design prototypes and pre-production models, which will not be sold, shall have been used for the following tests.

- a. Maximum power (kW).
 - b. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
 - c. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-22.40 and 16.40.
 - d. Governor speed regulation under steady-state and transient conditions.
 - e. Voltage regulation and generator transient response.
 - f. Fuel consumption at 1/4, 1/2, 3/4, and full load.
 - g. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
 - h. Alternator cooling air flow.
 - i. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
 - j. Endurance testing.
2. Supplier Tests: Prior to acceptance, the equipment shall be tested at full rated load through the use of resistive load banks. The tests shall be performed at the supplier's facility and must prove that the generator set is free of any defects and will perform to the specifications claimed by the supplier. The supplier shall furnish all consumables necessary for the tests. Block loading (50%, 75%, and 100% loads) shall be done in the presence of the owner's engineer or his appointed representative and shall be for a period of four hours. Transient responses, including voltage dips, frequency dips, and recovery time period, shall be measured and agree with the generator performance data submitted with the bid.
3. Site Tests: An installation check, start-up, and building load test shall be performed by the manufacturer's local representative. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
- a. Fuel, lubricating oil, and antifreeze shall be provided under this contract in conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
 - b. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery charger, generator strip heaters, etc.
 - c. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and frequency, and phase rotation.

PART 2 - PRODUCTS

2.1 GENERATOR

- A. The generator set shall be standby rated to provide 60 kW at 80% power factor, when operating at 120/208 volts 3-phase, 4-wire. The generator set shall be capable of this rating while operating in an ambient condition of 85°F (29.5°C) and 100 feet above sea level.
- B. The generator set shall be capable of maintaining 90% rated voltage at a motor starting load of 75 kVA.
- C. The complete generator assembly including batteries, controller, power distribution for engine heater, all accessories, controls and main breaker shall be housed in an arctic duty rated enclosure complete with thermostatically controlled motorized louvers and skid base mounted 300 gallon fuel tank.
- D. Vibration isolators shall be provided between the engine-generator and heavy-duty steel base.
- E. ENGINE
 - 1. The engine shall be diesel, 4 cycle, radiator and liquid cooled, producing 1.5HP per kW to operate at 1800 rpm for full electrical output rating. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories.
 - 2. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed.
 - 3. Skid-mounted radiator and cooling system rated for full load operation in 122° F (50° C) ambient as measured at the alternator air inlet. Radiator shall be prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture prior to shipping. Rotating parts shall be guarded against accidental contact.
 - 4. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. Provide vibration isolators between the engine generator assembly and the structural skid base. The base shall incorporate a battery tray with hold-down clamps within the rails
 - 5. Electric starter(s) capable of three complete cranking cycles without overheating.
 - 6. Full flow lubrication oil filters with replaceable spin on canister elements.
 - 7. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler if required for operation due to the design of the engine and the installation.
 - 8. Replaceable dry element air cleaner with restriction indicator.

9. Engine battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.
 10. Flexible supply and return fuel lines.
- F. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 80° C.

2.2 CONTROL AND MONITORING

- A. The generator set shall be provided with a microprocessor-based control system that is designed to provide monitoring, protection and control functions for the generator set.
- B. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.
- C. Control Switches
1. Mode Select Switch - The mode select switch shall initiate the following control modes.
 - a. When in the RUN position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable.
 - b. In the OFF position the generator set shall immediately stop, bypassing all time delays.
 - c. When in REMOTE position the generator will respond to an external contact closure (ATS source).
 2. EMERGENCY STOP switch - Switch shall be Red "mushroom head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down.
 3. RESET switch - The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 4. PANEL LAMP switch - Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
 5. VOLTAGE AND FREQUENCY ADJUSTMENT -The generator set control shall include digital raise/lower switches for adjustment of voltage and frequency.
- D. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

1. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current, frequency, and total load on generator set. Generator output voltage shall be available in line-to-line and line-to-neutral voltages.
2. Generator control shall contain analog meters displaying the following data: Line-to-neutral AC volts for each phase, line-to-line AC volts, AC current for each phase, frequency, and total load as a percentage of rated load capacity. Both analog and digital metering are required.

E. Generator Set Alarm and Status Display.

1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. At a minimum the control shall have separate indication lamps to indicate the following: SHUTDOWN, WARNING, and MANUAL RUN.
2. The generator set control shall indicate the existence of all alarm, shutdown, and status conditions associated with the generator set, on an alphanumeric display on the generator set control.
3. The generator set shall indicate the existence of warning and shutdown conditions on the generator set control panel for all of the following conditions:
 - a. low oil pressure (warning and shutdown)
 - b. oil pressure sender failure (warning)
 - c. low coolant temperature (warning)
 - d. high coolant temperature (warning and shutdown)
 - e. engine temperature sender failure (warning)
 - f. low coolant level (shutdown)
 - g. fail to crank (shutdown)
 - h. fail to start/overcrank (shutdown)
 - i. overspeed (shutdown)
 - j. low and high battery voltage (warning)
 - k. weak battery (warning)
 - l. low fuel level (warning)
 - m. low and high AC voltage (shutdown)
 - n. over and under frequency (shutdown)
 - o. over current (warning and shutdown)
 - p. field overload (shutdown)
 - q. loss of sensing voltage (shutdown)
 - r. emergency stop (shutdown)

- F. Provisions shall be made for indication of minimum two (2) customer specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions.

G. Engine Status Monitoring

1. The following information shall be available from the alphanumeric display panel on the generator set control:

- a. engine oil pressure
- b. engine coolant temperature
- c. engine speed (rpm)
- d. number of hours of operation
- e. number of start attempts
- f. battery voltage

H. Engine Control Functions.

1. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
2. The control system shall include the engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification.
3. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
4. The control system shall include sender failure monitoring logic which is capable of discriminating between failed sender or wiring components, and an actual failure condition.

I. Alternator Control Functions.

1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from improper operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level.
2. A microprocessor-based protection device shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set for more than 60 seconds. The device shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA 70 Article 445.
3. The control shall provide alternator protection from the following conditions:
 - a. high or low voltage
 - b. over/under frequency
 - c. over current warning/shutdown
 - d. loss of voltage sensing
 - e. field overload shutdown.

4. A microprocessor-based AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
- J. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel with connection to a remote alarm annunciator. Conditions that activate the remote audible device shall include:
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.
 6. Engine high temperature shutdown.
 7. Lube-oil, low-pressure shutdown.
 8. Overspeed shutdown.
 9. Emergency stop shutdown.
 10. Engine high-temperature pre-alarm.
 11. Lube-oil, low-pressure pre-alarm.
 12. Fuel tank, low-fuel level.
 13. Low coolant level.
- K. Remote Alarm Annunciator: Tabular LED multi-point type annunciator labeled to identify each alarm event, with a common audible signal activated for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
1. Provide 16-zone mini-annunciator suitable for 12 or 24 VDC operation as required, black indoor enclosure, UL listed, with machine-printed legend as specified. Manufacturer: Space Age Electronics M16 –BL-SMSB-LDxxD-SHT-O-x, or approved equal.
- L. Remote Emergency-Stop Switch: Wall mounted at location indicated on Drawings, and labeled. Outdoor push button shall be mounted in a NEMA 4X key lockable enclosure.

2.3 ACCESSORIES

- A. Provide exhaust silencer(s) of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall be critical grade. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.

- B. The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set, or as indicated on the drawings.
- C. Provide a fully automatic battery charger, sized as appropriate for the engine and batteries, as recommended by the engine manufacturer.
- D. Provide a thermostatically controlled UL499 Listed coolant heater, sized as recommended by the engine manufacturer to warm the engine to a minimum of 104F (40C) in a 40F (4C) ambient in compliance with NFPA 110. Coolant heater shall have provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set.
- E. Provide engine starting batteries. Starting batteries shall be calcium/lead antimony type, 12 or 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40F ambient temperature when fully charged.
- F. Provide spring type vibration isolators with seismic restraints, for mounting of the engine generator assembly. Provide anchorage calculations stamped by a professional engineer. Battery rack, and battery cables, capable of holding the manufacturer's recommended batteries, shall be supplied.
- G. The engine exhaust silencer shall be coated to be temperature and rust resistant, rated for residential application.
- H. Gas-proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.
- I. Exhaust manifold blanket.
- J. Exhaust condensation trap.
- K. Exhaust thimble and raincap.
- L. 10A, 120 VAC, SPDT, Dry, Form C contact outputs for engine run, common fault, generator in auto and generator low battery signals.

2.4 FUEL OIL SYSTEM

- A. Fuel Oil Filter:
 - 1. Turbine-type fuel oil filter/water separator to remove dirt, rust, water, and other contaminants, similar to Racor Turbine Series. Filter shall be rated for the full-load fuel flow of the generator and remove contaminants down to 10 microns. Filter shall include a centrifugal separator, waterproof cartridge filter element, clear collection bowl, self-venting drain, and wall-mount bracket. Provide with one spare filter in original packaging.

2. Turbine-type fuel oil filter shall be in addition to standard engine-mounted fuel filters.
- B. Base-Mounted Fuel Oil Storage Tank: Comply with NFPA 30. Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
1. Capacity: Fuel for not less than twelve (12) hours' continuous operation at 100 percent rated power output.
 2. Vandal-resistant fill cap.
 3. Containment Provisions: Double wall tank with integral rupture basin. Capacity shall comply with requirements of authorities having jurisdiction.
 4. Tank level indicators:
 - a. Mechanical indicator on tank
 - b. Electronic transmitter on tank for remote level indication on control panel.
 5. Fuel Tank Monitoring:
 - a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of a tank leak, with auxiliary contacts for remote monitoring.
 - b. Liquid Level Sensor: Multi-point liquid level sensor operates device contacts as follows:
 - 1) High/High-Level: operates at midpoint between overflow level and 100 percent of normal fuel level.
 - 2) High-Level: operates at 100 percent of normal fuel level.
 - 3) Low-Level: operates at 25 percent of normal fuel level.
 - 4) Low/Low-Level: operates at 6 percent of normal fuel level.
 6. Day Tank Provisions: Factory-fabricated with fuel tank assembly, with integral, float-controlled supply and return transfer pumps and the following features
 - a. Supply Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine. Pump shall provide a minimum of 17 feet of vertical lift at sea level, with 120VAC motor, size as required.
 - b. Return Pump Capacity: Equal to or greater than capacity of supply pump. Equip with 120VAC motor, size as required.
 - c. Piping Connections:
 - 1) Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, and overflow line.
 - 2) Field-installed fuel supply and return lines from tank to exterior bulkhead fittings for connection to remote bulk-tank.
 - a) Provide a normally-closed solenoid valve in supply and return lines, interlocked with automatic pump operation and shutdowns as required.
 - 3) Arrange piping with fittings and valves for anti-siphon protection.
- C. Fuel Tank Control and Monitoring Panel: Control panel complying with UL 353 and UL 508, with local indication, control interlocks, and terminals for connections to generator fuel oil storage tank-mounted devices, fuel-oil supply and return pumps, fuel-oil supply and return solenoid shut-off valves, and remote alarm annunciator panel. All signals and alarms shall be indicated on panel by LED indicators. Include panel features as follows:

1. Power source: 120VAC
2. LED pilot light status indicators:
 - a. Power on.
 - b. Fuel tank overflow high level alarm.
 - c. Fuel tank underfill low level alarm
 - d. Fuel tank leak detection alarm.
 - e. Fuel-oil supply solenoid valve open (energized).
 - f. Fuel oil return solenoid valve open (energized).
 - g. Fuel-oil supply pump on.
 - h. Fuel-oil return pump on.
3. Fuel tank fuel level indication (0 to 100 percent). Analog or digital indicator.
4. Audible alert, silence and test pushbutton switches.
5. Auxiliary alarm contacts: All alarm conditions shall provide form C (SPDT) contacts for remote annunciation (3 Amps at 120 VAC). In addition to other alarms, include relay contacts for the following:
 - a. Fuel tank derangement (summary) alarm.
6. Hand-Off-Auto switch for supply pump.
 - a. Automatic supply pump operation: Pump on at 50% of day-tank capacity, off at 100% of capacity.
7. Hand-Off-Auto switch for return pump.
 - a. Automatic return pump operation: Pump shall be operated by a separate, critical high-level float switch. Pump on at 110% of day-tank capacity, off at 100% of capacity.
8. Control Sequence:
 - a. Supply pump: With supply pump control switch in Auto position, when fuel tank level is drawn down to low-level (25%), supply pump starts and supply solenoid valve opens to allow fuel flow to refill base-mounted tank. When fuel level rises to high-level (100%), supply pump stops and solenoid valve closes to stop fuel flow.
 - b. Return pump: With return pump control switch in Auto position, if fuel tank level rises to high-high level, the fuel-oil return pump automatically starts and runs until fuel level drops to normal high-level (100%), at which point the pump stops.
 - c. The following conditions signal a local and remote alarm:
 - 1) High-High fuel tank level.
 - 2) Low-Low fuel tank level.
 - 3) Fuel tank leak detection.
 - d. Level Alarms:
 - 1) High-Level Alarm: Liquid-level sensor device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.
 - 2) Redundant High-Level Fuel Shutoff: Actuated by high-level alarm sensor in day tank to operate a separate return pump (with HOA switch in Auto) and disconnect the day-tank pump motor (with HOA switch in any position). Sensor shall signal solenoid valve, located in fuel suction line between fuel storage tank and day tank, to close. The day-tank pump and supply solenoid valve shall

- remain in shutoff state until manually reset. Shutoff action shall initiate an alarm signal to control panel but shall not shut down engine-generator set.
- 3) Low-Level Alarm: Liquid-level sensor operates alarm contacts at 25 percent of normal fuel level.
 - 4) Critical Low-Level Shutoff Alarm: Activates at 6 percent of tank capacity.
- e. Local alarm sequence: Alarm pilot light illuminates and panel-mount audible device sounds. Audible alarm is silenced by depressing silence push-button. Horn resounds upon subsequent alarms. Alarm pilot light extinguishes when condition is cleared. All lights illuminate when test push-button is depressed; holding test button for 5 seconds will test horn.
- D. Fuel System Pumps:
1. Supply Pump: Size transfer pump as required for 3/4 inch fuel-oil supply line and approximately 8 foot lift from fuel oil tank in utility building.
 2. Return Pump: Size transfer pump as required for 3/4 inch fuel-oil return line and approximately 8 foot lift to fuel oil tank in utility building.
 3. Pumps shall be UL listed, and suitable for fuel oil service and 120VAC power supply.
- E. Fuel System Shutoff Solenoid Valves: 3/4 inch, supply and return valves suitable for fuel oil service, normally closed, with 115VAC solenoid actuator.
- F. Fuel oil interconnects, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment, Articles 2.4 and 2.5.

2.5 OUTDOOR GENERATOR-SET ENCLOSURE

- A. General Description: Prefabricated or pre-engineered walk-in enclosure, suitable for arctic environment. Galvanized painted steel or painted aluminum, metal-clad, integral structural-steel-framed building or manufactured fiberglass enclosure erected on steel skids for transportation to the site and handling during installation. Steel framework shall be connected by welding.
1. Enclosure shall be built off site with generator set and controls fully installed and tested prior to being shipped to the site.
 2. This specification allows for a standard conex enclosure to be modified as required for compliance with the requirements of this Section.
- B. Regulatory Requirements: Provide enclosure meeting requirements of 2012 International Building Code (IBC).
1. Foam Plastics: Comply with IBC 2603, including listing and provisions for thermal barrier per IBC 2603.4.
- C. Performance Criteria:
1. Structural Performance: Provide enclosure capable of withstanding effects of gravity loads and site conditions, with structural loading criteria as follows:

- a. Wind Load – 130MPH
 - b. Snow Load – 160PSF
 - c. Live Floor Load – 300PSF
 - d. Seismic – Zone 4
 - e. Exposure Level – D
2. Seismic Performance: Provide enclosure capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
 3. Thermal Movements: Provide enclosure that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces

D. Walk-In Enclosure Construction:

1. Envelope assemblies: Products shall be UL or FM-listed as required by building code, with fire and smoke ratings of all materials used in the building walls, ceilings, and floors submitted for review. Interior surfaces shall be fire resistant, hard, durable, washable, and resistant to fuel oil solvent damage, and white in color. Exterior shell shall be hard, durable, and vandal resistant. Floor shall be non-skid metal, level surface without obstructions. All exterior assemblies shall be vapor-tight, and designed with thermal breaks to eliminate direct conduction through metal components.
2. Thermal Insulation: Exterior roof, wall, and floor assemblies shall be insulated to provide a minimum thermal resistance of R-30, except fire-rated panels may have a minimum thermal resistance of R-24, and as required to maintain winter interior temperature within range specified and operating limits required by engine-generator-set components.
3. Base/Floor Assembly:
 - a. Skids: W12 x 26 A-36 steel beams, with 5-inch Schedule 40 pipe with 1/2-inch steel end caps attached perpendicular to skids at each end for tail rolling.
 - b. Cross Members: C6 x 8.2 intermediate cross members at 24 inches on center, with W8 x 21 end cross members.
 - c. Floor: 3/16-inch-thick minimum steel plate, seam welded. Floor to be protected with MC10 x 15.3 channels located above forklift pocket holes.
 - d. Insulate base/floor assembly below floor with continuous minimum R-30 with thermal breaks to eliminate direct conduction through metal components.
4. Roof/Ceiling Assembly: Provide positive slope for roof drainage, arched to minimum of 4 inches or sloped at a minimum of 1/4 inch per foot.
5. Man Doors: 1-3/4 inches thick by 36 inches wide by 6'-8" high; insulated commercial type hollow metal door and frame as manufactured by Amweld, Ceco, Curries or preapproved equal. Equip doors with exit device, three stainless steel butt hinges, overhead stops, and full weather stripping.

- a. Exit Device: Panic bar on interior side, with exterior lever handle and removable cylinder capable of being master keyed.
 - 1) Provide manufacturer specific door hardware cylinder lock to match existing facility hardware. Coordinate with Owner Representative to identify the master keyed door hardware requirements.
 6. Muffler Location: Internal to enclosure.
 7. Removable Generator Access Panel: Provide removable wall panel of same construction as walls, sized to permit removal of generator skid. Provide panel with interior refrigeration type latches and gasketing, with centering spline in the bottom to keep panel securely in place.
 8. Finish: Two-coat enamel finish over cleaned and primed surfaces. Obtain Owner approval for finish color scheme. Assume single color scheme for basis of bid.
- E. Foundation: Bolt the walk-in enclosure skid to foundation on grade. See Civil Drawings for details.
- F. Generator Enclosure Electrical:
1. Electrical Service: Provide 208/120-volt, three phase, four wire distribution and branch circuit panelboards as indicated on the drawings. Wire the lights, unit heater and convenience outlets, generator heaters, ventilation controls, etc. to this panel. All circuits shall be in raceways. Panelboard shall comply with Section 26 24 16, and be of the same manufacturer and type as new panelboards for the Project. Raceways and wiring shall meet the relevant requirements of Division 26 sections of the project specifications.
 2. Interior Lights with Switch: Factory-wired, gasketed, vapor-tight LED type fixtures as indicated on the drawings arranged to illuminate controls and accessible interior.
 3. Convenience Outlets: Factory wired, GFCI as indicated on the drawings. Wiring devices shall be 20A rated and heavy-duty specification grade, mounted in cast metal boxes.
- G. Generator Enclosure Heating and Ventilation:
1. Space Heater: Electric unit heater with fan cycled by space thermostat. Unit heater shall be sized to maintain 45 deg F space temperature with an outside design temperature of minus 40 deg F and infiltration from a 100-mph wind. Size heater based on heat loss calculation; do not arbitrarily oversize the heater. Refer to Drawings.
 2. Louvers and Ventilation: Louvers equipped with bird screen and filter; arranged to seal off outside openings when engine is not running, and exclude entry of dust, birds, and rodents.
 3. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 4. Ductwork and weather hoods: Snow hoods based on 'arctic-tee' design, as required to baffle wind driven snow and reduce air intake velocity to drop out ice particulates. Refer to fabrication details on Drawings. Weather hoods shall be sheet metal or fiberglass and finished to match building. Hoods shall extend a full 90 degrees, be sealed weathertight to the building, and the opening covered with heavy gage bird screen. Hoods shall be supported from the building and provided with internal and/or external structural supports

to resist snow and wind loads present at the project site. Hoods shall provide an opening area sufficient to meet maximum air speed limits:

- a. Intake air: 550 fpm at hood opening, 700 fpm at dampers.
 - b. Exhaust air: 1000 fpm.
 - c. Recirculated air: 1000 fpm.
5. Dampers: Intake and exhaust control dampers shall meet the requirements for low-leakage applications, and shall have neoprene blade seals. Install dampers at the enclosure wall in the intake and exhaust air openings. Install recirculation dampers in the exhaust ductwork plenum between the radiator and exhaust damper to provide room heating as indicated on Drawings.
 6. Damper actuators: Modulating type, with spring return, 24VDC.
 7. Ventilation Controls: Stand-alone control system to control intake, exhaust, and recirculation dampers to maintain an adjustable room temperature set point. Consolidate components and wiring landed on terminal strips in the ventilation control panel (VCP) as indicated on Drawings. Controls shall include a room thermostat and all additional components required to accomplish the ventilation sequence of operations.

H. Ventilation Operating sequence:

1. Generator not running:
 - a. Intake and exhaust dampers closed.
 - b. Recirculating dampers open.
 - c. Intake and exhaust dampers open to 50% if room temperature exceeds 80 deg F (adjustable).
 - d. Intake and exhaust dampers close completely when room temperature falls below 75 deg F (adjustable).
2. Generator starts:
 - a. Intake dampers open to 25 percent.
 - b. Exhaust damper opens to 20 percent.
 - c. Recirculating dampers remain open to 100 percent.
 - d. Shut down space heater and engine jacket heater.
3. Generator running:
 - a. Intake, exhaust, and recirculating dampers modulate to maintain room set point of 80 deg F (adjustable).
4. Generator stops:
 - a. Recirculating dampers open to 100 percent.
 - b. Intake and exhaust dampers close to 50 percent.
 - c. Intake and exhaust dampers close completely when room temperature falls below 75 deg F (adjustable).
 - d. Enable space heater and engine jacket heater.
5. Control power failure: Intake and exhaust dampers spring return to open position.

2.6 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned engine-generator assemblies and accessories.
- B. Clean and repair existing engine-generator assemblies to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install engraved plastic nameplates in accordance with Section 26 05 53.
- B. Ground and bond generator and other electrical system components in accordance with Section 26 05 26.
- C. Install generator enclosure at location shown on Drawings. Set enclosure plumb and aligned. Level true to plane with full bearing on skid assembly.
- D. Connect electrical power service and control circuits in accordance with Division 26 requirements and as indicated on Drawings.
- E. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- F. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- G. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch (25 mm).

- H. Install Schedule 40, black steel piping with welded joints and connect to engine muffler with flexible connection to engine as required. Install thimble at wall. Piping shall be same diameter as muffler outlet.
- I. Install condensate drain piping to muffler drain outlet, same size as drain connection with a shutoff valve, and stainless-steel flexible connector. Drain piping shall be Schedule 40, black steel pipe with welded joints.
- J. Insulate muffler and exhaust piping using factory-fabricated high-temperature blankets designed for use on the muffler installed.
- K. Install ventilation equipment and controls to operate in accordance with the sequence of operations.
- L. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
- M. Piping installation requirements shall comply with Engine Generator manufacturer's written requirements, and shall comply with the State of Alaska Mechanical Code. Drawings indicate general arrangement of piping and specialties.

3.3 FIELD QUALITY CONTROL

- A. Section 01 45 00 - Quality Control; Section 01 77 19 - Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.22.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Section 01 45 00 - Quality Control: Manufacturer's field services.
- B. Prepare and start up engine-generator assembly.

3.5 ADJUSTING

- A. Section 01 77 19 - Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust generator output voltage and engine speed to meet specified ratings.

- C. Adjust enclosure doors and hardware to operate smoothly, easily, properly, and without binding. Confirm locks and hatches engage accurately and securely without forcing or binding.
- D. Lubricate hardware and other moving parts of enclosure.

3.6 CLEANING

- A. Section 01 77 19 - Closeout Requirements: Final cleaning.
- B. Clean engine and generator surfaces. Replace oil and fuel filters with new.
- C. Clean all enclosure surfaces. Ensure all surfaces are free of oil and other contaminants.
- D. After installation, inspect exposed finishes and repair any damage caused during construction.

3.7 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generator and enclosure ventilation. Furnish 4 hours of instruction each for two persons, to be conducted at project site with manufacturer's representative. Coordinate this training to be conducted concurrently with training for Enclosed Transfer Switches.
- B. Simulate power outage by interrupting normal source, and demonstrate system operates to provide automatic operation of standby power. Demonstrate that all controls, alarms and shutdown features are operational.

END OF SECTION

SECTION 26 34 00**POLE LINE HARDWARE****PART 1 - GENERAL****1.1 SCOPE**

- A. Install an aerial power and control distribution system with overhead conductors and data on wood poles. The installation shall be complete with all necessary components including conduit, conductors, line hardware, and related equipment.
 - 1. Provide an overhead power feeder and control service drop between the Generator module and the Utility Building.
 - 2. Provide a new overhead power feeder segment as indicated on Drawings between the generator module and lift station adjacent to the water storage tank.
- B. The complete installation as specified in this section shall comply with the requirements set forth in Section 26 00 00. The installation shall meet the requirements of Type N construction using the NESC Alaska 'heavy' loading for ice, wind and temperature.
- C. The Contractor shall coordinate and comply with UVEC requirements when working on or near UVEC's existing distribution system at the site.

1.2 QUALIFICATIONS

- A. The Contractor shall be an established company that has at least five years of experience installing line work in Alaska. The company shall have the necessary installation and testing equipment to meet the requirements of this specification.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittals: Submittal procedures.
- B. Product data: Submit data for all products and materials.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 77 19 - Closeout Requirements: Closeout procedures.
- B. Section 01 78 39 - Project Record Documents: Record the as-built installation.

PART 2 - PRODUCTS

2.1 POLES

- A. Wood poles shall be pressure treated wood, length and class as indicated on the Drawings. Provide longer poles as needed to meet vertical clearances required by the NESC. Wood poles shall be Douglas Fir or Southern Pine and shall meet the standards of the ANSI 05.1, pressure treated in accordance with AWWA. Poles markings (type, length, class, etc.) shall be approximately ten feet from the base.
- B. Poles shall be double wrapped with 6 mil polyethylene sheeting from the butt of the pole to 6 inches above grade. Backfill shall be done in 6 inch lifts and each lift compacted. Surplus earth shall be placed at the base of the pole in a conical shape and packed tightly. Pole burial depth shall be as follows:

Pole Length	Setting Depth
20	5 feet - 0 inches
25	5 feet - 6 inches
35	6 feet - 0 inches
40	6 feet - 0 inches
45	6 feet - 6 inches

2.2 LINE HARDWARE

- A. Provide all necessary components for a complete and properly operating system including, but not limited to the following items. Construction shall provide a strength exceeding the rated breaking strength of the messenger cable.
- B. Overhead conductors shall be supported on clevis fittings with spool insulators – Class 53-4; attachment shall be with 5/8 inch through bolts (minimum size). Chance, Joslyn Victor or accepted equal.
- C. Overhead conductors shall be attached with wedge clamp, Blackburn W-1 series or accepted equal. Each device suitable for type and size of cable.
- D. Splices to fixtures shall be compression type, suitable for type and size of cable, Blackburn Type WR series or accepted equal. Conductor shall be coated with oxide inhibitor. Splices shall be housed in a compression sleeve, hinged polyethylene cover, Blackburn Type C series or accepted equal.
- E. Guys (if required) - 5/8 inch galvanized oval eyebolt, 6 inch screw anchor with thimble eye, 7 foot long rod, 3/8 inch 7 strand, Siemen Martin galvanized steel wire with clamps, and appropriate guy attachments. Guys shall be provided at angles, corners, and deadends. Where a single guy does

not provide adequate strength, two guys shall be provided. For steep terrain where a down guy length is excessive, install a sidewalk guy.

2.3 OVERHEAD CONDUCTORS

- A. Overhead conductors shall be self-supporting cables Type N-SD aluminum conductor with bare ACSR messenger, XLPE insulation. The conductors shall be as scheduled on the Drawings.

2.4 LABELS

- A. Each pole shall have plastic or metal label with pole number attached to the pole at approximately 5 foot above grade. Labels shall be fastened with screws or nails. Refer to 26 05 53 for labeling information.

2.5 SAG AND TENSION

- A. Submit manufacturer's sag and tension data for the overhead conductors prior to cable installation. Comply with sag and tension requirements set forth by the manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractor shall be responsible for clearing as necessary to allow the installation of poles, overhead conductors, guys, etc. The Contractor shall cut vegetation to maintain a two foot clearance in all directions from the conductor, pole and fixture installed in this work. It is anticipated that this type of work will be minimal. Contractor shall visit the site to determine the amount of brushing required.
- B. When open trenches or holes are left open overnight, provide barricades and signage as required to prevent the general public from driving, riding or walking into them.
- C. At the completion of the project, the Contractor shall leave the roadways and adjacent areas in the same state as they were at the beginning of the project. In general, fill in and compact all ruts; clear off all brush, etc.

3.2 QUALITY CONTROL

- A. Section 01 45 00 - Quality Control; 01 77 19 - Closeout Requirements: Field inspecting, testing, adjusting, and balancing

3.3 TESTING AND TRAINING

- A. Demonstrate proper operation of the line work by operating the lighting, power, and control systems. The substantial completion inspection will consist of the following:
1. Confirm poles are properly set and plumb or raked as specified.
 2. Conductors are sagged and tensioned per manufacturer's recommendation
 3. Guys are properly installed.
 4. Demonstrate that the connected equipment and associated controls operate.
 5. Repair and replace components or wiring that fails during the testing. Retest the repaired system.

END OF SECTION

SECTION 40 00 00.05
PROCESS CONTROL AND INSTRUMENTATION GENERAL

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. A System Integrator shall provide or coordinate with the Original Equipment Manufacturer (OEM) and other vendors providing any Process Control and Instrumentation System (PCIS) instruments, sensors and control panels complete and operable, in accordance with the Contract Documents and may also serve the role of Instrument Supplier and OEM. All initial calibration, programming and configuration shall be done by or under the direction of the System Integrator. The intent is to have a single point of contact for the Instrumentation and Control systems for the entire project.
- B. The System Integrator along with qualified electrical and instrumentation installers shall be responsible for the installation, testing and commissioning of the PCIS.
- C. The requirements of this Section apply to all components of the PCIS, unless indicated otherwise.
- D. Responsibilities
 - 1. The OEM shall be responsible for
 - a. Providing the final design and layout of the control panel components,
 - b. Preparing submittals and or pre-approving submittals from others
 - 1) Pre-construction set for review, and
 - 2) As-built set upon completion of testing.
 - c. Construct panel based on approved submittals,
 - d. Prepare test plan and implement in the presence of owner's representative.
 - e. Prepare Technical Manual covering components and software.
 - f. Submit software and programs as specified elsewhere.
 - 2. Qualifications: The OEM shall have the resources, space, and personnel needed to design and fabricate the panels. The OEM shall meet the following minimum qualifications:
 - a. The OEM 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.
 - b. The OEM 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, or the panel builder shall build to an equal standard, shall be certified to an equal standard, and shall attach a label to all new panels with a label that is acceptable to the State of Alaska Department of Labor, Mechanical Inspections Division.
 - c. Panel to be constructed in the U.S.
 - 3. The Engineer or other designated Owner representative shall perform the following Work:
 - a. review the test plan, the training plan, and the spare parts submittals

- b. oversee and certify hardware installation,
 - c. oversee, document, and certify loop testing,
 - d. modify or assist System Integrator in modifying Recorder and Screen software after installation and during the pre-commissioning and commissioning phases,
4. Additional requirements in this Section and throughout Division 40 which are stated to be the Engineer or Owner's representative's responsibility may be performed by the System Integrator on a negotiated basis.

1.2 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00.
1. Exchange of Technical Information: During the period of preparation of these submittals, the System Integrator shall authorize a direct, informal liaison with the Engineer for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as indicated may be authorized informally by the Engineer, but will not alter the scope of work or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the Engineer shall be construed to give approval of any component or method, nor shall any statement be construed to grant exception to or variation from these Contract Documents.
 2. Symbology and Nomenclature: In these Contract Documents, all systems, all meters, all instruments, and all other elements are represented schematically, and are designated by symbology as derived from Instrument Society of America Standard ANSI/ISA S5.1 – Instrumentation Symbols and Identification. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, and similar materials. No other symbols, designations, or nomenclature unique to the manufacturer's standard methods shall replace those prescribed above, used herein, or on the Drawings.
- B. Shop Drawings
1. General
 - a. Shop Drawings shall include the letterhead or title block of the panel Supplier. The title block shall include, as a minimum, the panel Supplier's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing. The quantity of submittal sets shall be as indicated in Section 01 33 00.
 - b. Organization of the Shop Drawing submittals shall be compatible with eventual submittals for later inclusion in the Technical Manual.
 - c. Shop Drawing information shall be bound in standard size, three-ring, loose-leaf, vinyl plastic, hard cover binders suitable for bookshelf storage. One set of drawings for each facility is to be hung inside each panel. The drawings are to be enclosed in PVC pockets suitable for hanging from a 3-ring binder, two drawings per pocket. The ring binder is to be attached to the inside of the front panel door.
 - d. Interfaces between instruments, motor starters, control valves, variable speed drives, flow meters, chemical feeders and other equipment related to the PCIS shall be included in the Shop Drawing submittal.

2. Test Procedure Submittals
 - a. The System Integrator shall submit the proposed procedures to be followed during tests of the PCIS and its components.
 - b. Preliminary Submittal: Outlines of the specific proposed tests and examples of proposed forms and checklists.
 3. The System Integrator shall provide a submittal of their certifications, and project history before submitting any Shop Drawings or commencing any work on the control panels.
- C. O&M – See 01 77 19 for O&M requirements
- D. As-Built Drawings

The System Integrator shall keep current a set of complete schematic diagrams which shall include all field and panel wiring connections, cable, wire, and termination numbers. These drawings shall include all instruments and instrument element connections at the CP. Two sets of drawings electronically formatted in AutoCAD on CD-ROM and two hard copies shall be submitted after completion of all commissioning tasks. All such drawings shall be submitted for review prior to acceptance of the completed work by the Owner.

1.3 WARRANTY

The warranty shall start from the date of final acceptance of the completed panel, and shall extend for 1 year.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Code and Regulatory Compliance: PCIS WORK shall conform to or exceed the applicable requirements of the National Electrical Code and local building codes.
- B. Current Technology: Meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the Shop Drawings, unless otherwise required to match existing equipment.
- C. Hardware Commonality: Instruments which utilize a common measurement principle (for example, d/p cells, pressure transmitters, level transmitters which monitor hydrostatic head) shall be furnished by a single manufacturer. Panel-mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single manufacturer.
- D. Instrument and Loop Power: Power requirements and input/output connections for all components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of "2-wire" transmitters is preferred, and use of

"4-wire" transmitters shall be minimized. Individual loop or redundant power supplies shall be provided as required by the manufacturer's instrument load characteristics to ensure sufficient power to each loop component. Power supplies shall be mounted within control panels or in the field at the point of application.

- E. Loop Isolators and Converters: Signal isolators shall be provided as required to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wirewound resistors shall be installed at all field side terminations in the control panels to ensure loop integrity. Signal conditioners and converters shall be provided where required to resolve any signal level incompatibilities or provide required functions.
- F. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. . Enclosures suitable for the environment shall be furnished. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.
- G. Alternative Equipment and Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the ENGINEER through the "or equal" process of Section 26 00 00 – Electrical Materials and Methods. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available. To match existing equipment and future equipment being installed under other contracts, equipment substitutions for equipment specified as no equal will not be accepted.

2.2 OPERATING CONDITIONS

The PCIS shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:

- | | | |
|-----------------------------|---|---------------------------------------|
| 1. Environment | - | water treatment/supply facility |
| 2. Indoor Temperature Range | - | 32 through 84 degrees F |
| 3. Relative Humidity | - | 20 through 90 percent, non-condensing |
| 4. Seismic Zone 4 | | |

2.3 SPARE PARTS AND SPECIAL TOOLS

- A. The System Integrator shall provide the following:
 - 1. Spare parts as listed in equipment specifications in Division 40.
- B. The System Integrator shall furnish a priced list of all special tools required to calibrate and maintain the instrumentation provided under the Contract Documents. After approval, the System Integrator shall furnish tools on that list.

- C. Special tools and spare parts shall be submitted before startup commences, suitably wrapped and identified.

PART 3 - EXECUTION

3.1 PRODUCT HANDLING

- A. Shipping Precautions: After completion of shop assembly, factory test, and approval, equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the Site.
- B. Special Instructions: Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

3.2 INSTALLATION

- A. General
 - 1. Instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 40 and the manufacturers' instructions.
 - 2. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the Owner exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the System Integrator shall make such changes without additional cost to the Owner.
- B. Conduit, Cables, and Field Wiring
 - 1. Conduit shall be provided under Division 26.
 - 2. Process equipment control wiring signal wiring to field instruments and other field wiring and cables shall be provided under Division 26.
 - 3. Terminations and wire identification at PCIS equipment furnished under this or any other Division shall be provided under Division 40.
- C. Sampling Tubing and Instrument Bodies
 - 1. Route sample lines a required for individual instruments so as to minimize exposure to contact or damage.

2. Provide instrument sample drainage tubing using nearest waste port.
 3. Provide identification of new sampling port – “pH sample port AIA 321”
- D. Instrumentation Tie-Downs: Instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements applicable to the Site.
- E. Ancillary Devices: The Contract Documents show all necessary conduit and instruments required to make a complete instrumentation system. The System Integrator shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements. Such additions and such changes, including the proposed method of installation, shall be submitted to the Engineer for approval prior to commencing the Work. Such changes shall not be a basis of claims for extra work or delay.
- F. Installation Criteria and Validation: Field-mounted components and assemblies shall be installed and connected according to the requirements below:
- G. Installation personnel have been instructed on installation requirements of the Contract Documents.
1. Technical assistance is available to installation personnel at least by telephone.
 2. Installation personnel have at least one copy of the approved Shop Drawings and data.
 3. Flexible cables, sampling and capillary tubing shall be installed in flexible conduits where exposed to physical contact or potential harm. The lengths shall be sufficient to withdraw the element for periodic maintenance.
 4. Power and signal wires shall be terminated with crimped type lugs.
 5. Connectors shall be, as a minimum, watertight.
 6. Wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.
 7. Wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices, unless specifically approved by the Engineer. Wiring shall be protected from sharp edges and corners.
 8. Mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.
 9. Verify the correctness of each installation, including polarity of electric power and signal connections, and make sure process connections are free of leaks. The System Integrator shall certify in writing that discrepancies have been corrected for each loop or system checked out.
 10. The Owner will not be responsible for any additional cost of rework attributable to actions of the System Integrator, OEM or the Instrumentation Supplier.

3.3 CALIBRATION

- A. General: Devices provided under Division 40 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

- B. Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the Engineer.
- C. Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.
- D. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:
 - 1. Project name
 - 2. Loop number
 - 3. Tag number
 - 4. Manufacturer
 - 5. Model number
 - 6. Serial number
 - 7. Calibration range
 - 8. Calibration data: Input, output, and error at 20 percent, 60 percent and 100 percent of span
 - 9. Switch setting, contact action, and deadband for discrete elements
 - 10. Space for comments
 - 11. Space for sign-off by Instrumentation Supplier and date
 - 12. Test equipment used and associated serial numbers
- E. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the Engineer or Owner. The System Integrator shall have the Instrumentation Supplier sign the tag when calibration is complete. The Engineer or Owner will sign the tag when the calibration and testing has been accepted.

3.4 LOOP TESTING

- A. General: Individual instrument loop diagrams per ISA Standard S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the Engineer for review prior to the loop tests. The System Integrator shall notify the Engineer of scheduled tests a minimum of 30 days prior to the estimated completion date of installation and wiring of the PCIS. After the Engineer's review of the submitted loop diagrams for correctness and compliance with the Specifications, loop testing shall proceed. The loop check shall be witnessed by the Engineer.
- B. Control Valve Tests: Control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to insure that no changes have occurred since the bench calibration.

- C. Instrument and Instrument Component Validation: Each instrument shall be field-tested, inspected, and adjusted to its indicated performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer or Owner and at the System Integrator's expense.
- D. Loop Validation: Controllers and electronic function modules shall be field-tested and exercised to demonstrate correct operation of the hardware and wiring. Control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested.
- E. Loop Validation Sheets: The System Integrator shall prepare loop confirmation sheets for each loop covering each active instrumentation and control device including simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the Instrumentation Supplier:
1. Project name
 2. Loop number
 3. Tag number, description, manufacturer and model number for each element
 4. Installation bulletin number
 5. Specification sheet number
 6. Adjustment check
 7. Space for comments
 8. Space for loop sign-off by Instrumentation Supplier and date
 9. Space for Engineer witness signature and date
- F. Loop Certifications: When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of each test form signed by the Engineer, Owner or the Owner's representative as a witness, with test data entered, shall be submitted to the Engineer together with a clear and unequivocal statement that the instrumentation has been successfully calibrated, inspected, and tested.

3.5 PERFORMANCE TEST

- A. The entire PCIS hardware, field instruments, power supplies, and wiring shall operate for 30 days without failure.
- B. The System Integrator shall furnish support staff as required for initial startup of the individual panels. Personnel provided shall be fully versed in the required design parameters and be prepared to alter programming and circuitry as needed to integrate the controls and provide a complete and operational system. Provide personnel for 5 days on site,

- C. If any component, other than field instruments, fails during the performance test, it shall be repaired or replaced and the PCIS shall be restarted for another 30-day period.

3.6 REQUIREMENTS FOR COMPLETION

- A. For the purpose of this Section, the following conditions, in addition to the requirements stated elsewhere, shall be fulfilled before the WORK is considered substantially complete:
 - 1. Submittals have been completed and approved.
 - 2. The PCIS has been tested and approved.
 - a. All instruments calibrated and operationally tested.
 - b. Valve operation
 - 1) Manual operation demonstrated successfully
 - 2) Automatic operation simulated
 - 3. Spare parts and expendable supplies and test equipment have been delivered to the Engineer.
 - 4. The performance test has been successfully completed.
 - 5. Punch-list items have been corrected.
 - 6. As-built drawings in both hard copy and electronic format have been submitted.
 - 7. Revisions to the Technical Manuals that may have resulted from the factory tests have been made and reviewed.
 - 8. Debris associated with installation of instrumentation has been removed.

END OF SECTION

SECTION 40 05 23**PROCESS VALVES****PART 1 - GENERAL****1.1 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 22 10 00 Plumbing piping Valves and specialties

1.2 SCOPE OF WORK

- A. This section covers all valves within structures and located under and outside of building.

1.3 QUALITY ASSURANCE

- A. All valves and operators must conform to ANSI/NSF 61 standards.
- B. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified.
- C. All valves of the same type shall be by a single manufacturer.

1.4 SUBMITTALS

- A. Certificates: Submit manufacturer's certificates of conformance.
- B. Test Reports: Submit certified copies of test reports.
- C. Catalog Data: Submit manufacturer's literature and illustrations.
- D. Shop drawings of valves and operators:
 - 1. Dimensions.
 - 2. Construction details.
 - 3. Materials.
- E. Installation and Maintenance Instructions: Complete manufacturer's instructions, including parts list and recommended spare parts.
- F. Weights: Statement of net assembled weight of each size of valve and operator furnished.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Seal valve ends to prevent entry of foreign matter into valve body.
- B. Box, crate, completely enclose, and protect valves, operators and accessories from accumulations of foreign matter.
- C. Store valves, operators and accessories in area protected from weather, moisture, or possible damage.
- D. Do not store material directly on the ground.
- E. Transport and handle items with care to prevent interior or exterior damage.
- F. Repair or replace damaged material to satisfaction of Engineer.

1.6 LISTING AND LABELING

- A. Per Division 26, Electrical.

PART 2 - PRODUCTS

2.1 FLOW CONTROL VALVES

- A. Control Valve
 - 1. Valve Type: Bray Series 31 lug or approved equal.
 - 2. Body:
 - a. Shall be one-piece lug design with extended neck to allow for 2” of piping insulation.
 - b. Flange hole drilling per ANSI 125# flange standard as specified.
 - c. A non-corrosive bushing and a self-adjusting stem seal shall be provided. No field adjustment shall be necessary to maintain optimum field performance.
 - 3. Disc:
 - a. Disc edge and hub on metal discs shall be spherically machined and hand polished for torque and maximum sealing capability.
 - 4. Stem:
 - a. Shall be one-piece design.
 - b. Disc to stem connection shall be an internal double “D” design with no possible leak paths in the disc-to-stem connection. External disc-to-stem connections such as disc screws or pins are not allowed.
 - c. Stem shall be mechanically retained in the body neck and no part of the stem shall be exposed to the line media.
 - 5. Seat:

- a. Shall be tongue-and-groove seat with a primary hub seal and a molded flange O-ring for weldneck and slip-on flanges.
- b. The seat shall totally encapsulate the body isolating it from the line media and no flange gaskets shall be required.
6. Testing:
 - a. Valve shall be tested to 110% of the rated pressure.
7. Pressure Ratings:
 - a. Valve shall be rated for bubble-tight shut-off at pressure rating shown below.
 - b. 2"-12" (50mm-300mm) 175 psi (12.0 Bar)
 - c. 14"-20" (350mm-500mm) 150 psi (10.3 Bar)
8. Approvals & Certifications:
 - a. CE/PED Certification
 - b. NSF/ANSI 61-2008 Certification (Potable Water)
 - c. SIL Certification
 - d. ABS Certification
 - e. Bureau Veritas Certification
 - f. DNV

B. Actuator

1. Actuator: Bray Series 70 Electric Actuator S70-006 or approved equal.
2. The actuator shall be compact and low profile to minimize space requirements.
3. The actuator shall be 90° operation.
4. The actuator shall provide easy access for field wiring and adjustment.
5. The actuator shall be built to withstand line vibration and shock without failure.
6. The actuator shall be sized with sufficient torque capabilities to operate the 4" butterfly valve.
7. Enclosure:
 - a. The enclosure shall be die-cast aluminum and polyester or Seacorr coated (as specified) for environmental protection.
 - b. The enclosure shall be provide with captive cover bolts to prevent loss of cover bolts when cover is removed.
 - c. The enclosure shall have two conduit connections (one for power wiring and one for control signal wiring) in either NPT or metric threads as specified.
 - d. The actuator enclosure shall be provided with a high visibility valve position display prominently labeled and color coded to indicate the valve position throughout the full range of travel.
8. Motor:
 - a. The motor shall be 24VAC.
 - b. The motor shall contain a built-in UL approved automatic reset thermal overload protector set at 275° F (135° C) embedded in the motor windings.
 - c. Motors shall be 24VAC as specified.
9. Actuator Gear Train System:
 - a. The actuator shall have a self-locking gear train system consisting of a worm and worm gear output drive mechanism, which will hold the valve in the desired position without the need for an electromechanical braking system.

- b. The spur gear train shall have precision cut multi-staged gears which will withstand locked rotor conditions and are permanently lubricated at the factory.
10. Mechanical Travel Stops:
- a. Mechanical stainless steel travel stops shall be provided and located outside the actuator enclosure for ease of adjustment.
 - b. Stainless steel lock nuts to hold the travel stops in position and O-ring seals for waterproof protection shall be provided.
 - c. The mechanical travel stops shall be capable of limiting the travel of the actuator in either direction from full closed to full open.
11. Manual Override:
- a. The actuator shall be equipped with a manual override hand wheel to rotate the valve without electrical power.
 - b. The manual override system shall ensure positive and efficient manual operation without the use of extra tools or levers.
12. Emergency Shut-off:
- a. An automatic power cutout switch shall be provided to cut power to the motor when the actuator manual override is engaged.
 - b. This cutout switch shall also function as a safety emergency power shutdown device and shall be accessible from outside the actuator enclosure.
13. Battery Backup
- a. In the event of external power failure, the valve shall be equipped with internal battery backup to provide return to individual valve positions as programmed – returning the valve to Bypass condition.
14. Travel Switches:
- a. All travel switches shall be:
 - 1) Single Pole, Double Throw Form C Type
 - 2) UL Listed and CSA Approved
 - 3) 10A at 125/250 VAC and 1/2A at 125 VDC
 - b. The Actuator switches shall be pre-wired to a terminal block for ease of access and all internal wiring shall range from 12-22 AWG.
 - c. The travel limit switches shall limit the actuator travel in both the open and closed direction of travel.
 - d. Cams for each travel limit switch shall be infinitely adjustable by finger touch or screw driver.
15. Service Requirements:
- a. Actuators shall be designed for electric operation for the following service conditions:
 - 1) Temperature ranges of -20°F (-29°C) to +150°F (+65°)
 - b. Duty Cycle:
 - 1) 25% for Intermittent Operation
 - 2) 100% for Continuous Operation
16. Testing:
- a. All actuators shall be factory tested to ensure proper operation.
17. Mounting:
- a. All actuators shall mount directly to the valve mounting flange and stem without the need for any brackets or couplings.
18. Approvals & Certifications:

- a. Actuators and Certifications:
 - 1) CE98/37/EC
 - 2) IEC IP65 Test Certification
 - 3) ABS
 - 4) Bureau Veritas Certification
 - 5) CSA Certification
 - 6) TUV IP65
19. Control characteristic shall be linear and duty cycle shall be 100%.
20. Separate Speed Control adjustments shall be provided for adjustment of open and close travel speeds.
21. Inputs for the control box, hand wheel, LED status indicators and self-diagnostic capability shall also be provided.
22. Enclosure:
 - a. The waterproof enclosure shall be certified to UL, CSA and CE (NEMA 4, 4X, IP 65) waterproof standards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 1. All valves and accessories will be installed in a manner and location as shown on the Plans or as required for the application and in accordance with manufacturer's instructions.
 2. Size of valve shall be equal to line piping in which valve is installed unless otherwise noted on the Plans.
 3. Support all valves where necessary.
 4. In case of conflict between these specifications and a governing code, the higher standard shall prevail.
 5. Orient butterfly valve stems in same plane as preceding elbows, when five pipe diameters of straight pipe runs cannot be provided on both sides of valve.
 6. Install check valves as recommended by the valve manufacturer to avoid disc chatter.
- B. B. Accessories:
 1. Provide all accessories necessary for proper valve operation as specified or required for the application.
- C. C. Valve Operators:
 1. Valves shall be installed with the operator in a position for convenient operation.
 2. Particular care shall be taken to insure that space is available for operation of lever or hand wheel operated valves without interference from walls, piping or equipment.
 3. Any valve which is installed, in the opinion of the Engineer, in a manner that operation is inconvenient shall be modified or removed and reinstalled in a manner suitable to the Engineer.

4. Operators for manual valves shall be lever or hand wheel as is standard with the manufacturer unless another type of operator is specified or required by the manufacturer.
 5. Do not install valves with operators pointing down.
 6. Do not install valves in location or position that would present a tripping, knee- or head-knocker hazard.
 7. Provide sufficient space for valve operation and removal. A minimum of 4 inches of knuckle clearance shall be provided around all hand valves.
- D. E. Valve Identification:
1. Plumbing Valves:
 - a. Identify valves of the plumbing systems to indicate their function and system served.
 - b. Provide list for approval prior to tagging or labeling.
 2. All valves must be fully identified by the manufacturer including size, manufacturer's name, and pressure rating.

3.2 ADJUSTMENTS

- A. Check and adjust valves and accessories for smooth operation.
- B. Lubricate in accordance with manufacturer's recommendations.
- C. All globe, angle and gate valves shall have their stuffing boxes packed with an excess of 30 percent of packing (for future adjustment).

3.3 TESTING

- A. Test with piping in accordance with the requirements described in Section, Pipe and Fittings.

END OF SECTION

**SECTION 40 95 13
PROCESS CONTROL PANELS AND HARDWARE**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pump control system including motor control contactors and overloads where applicable, pump alternation, switches, push buttons, indicating lights, display and control relays.
- B. Related Sections:
 - 1. Section 26 05 03 - Equipment Wiring Connections.
 - 2. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
 - 3. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
 - 4. Section 26 27 16 – Electrical Cabinets and Enclosures
 - 5. Section 40 00 00 – Process Measurement and Control

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Underwriters' Laboratories
 - 1. UL 508 - Industrial Control Equipment.

1.3 CONTROL PANEL SCOPE

- A. Bypass Panel
 - 1. This panel receives filter and composite NTU alarms from each turbidity monitor in the facility and annunciates visually, audibly and via telephone dialer and initiates the raw water transfer diverting raw water to a sump. Alarms remain active until acknowledged.
 - 2. Provides process start stop and displays status.
 - 3. Panel layout and ladder logic shall be as shown on the plans.

1.4 SUBMITTALS

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

- B. Control Panel Engineering Submittal: The Contractor shall submit a control panel engineering submittal (CPES) for each control panel and enclosure provided under Division 40. The CPES shall completely define and document the construction, finish, fuses, circuit breakers, internally-mounted hardware, communications hardware, and control system components. All panel drawings shall, as a minimum, be "B" size with all data sheets and manufacturer specification sheets being "A" size. The submittal shall be in conformance with ISA-S20 – Standard Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, shall be submitted as a singular complete bound volume or multi volume package within 60 calendar days after Notice to Proceed, and shall have the following contents:
1. A complete index shall appear in the front of each bound volume. All drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas. All panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.
 2. Scale construction drawings which define and quantify the type and gauge of steel to be used for panel fabrication, the ASTM grade to be used for structural shapes and straps, panel door locks and hinge mechanisms, type of bolts and bolt locations for section joining and anchoring, details and proposed locations for "UNISTRUT" members, stiffener materials and locations, electrical terminal box and outlet locations, electrical access locations, print pocket locations, writing board locations, and lifting lug material and locations.
 3. Cutout locations with nameplate identifications shall be shown.
 4. The Contract Drawing wiring diagrams shall be edited to identify electrical devices, terminals, and interconnecting wiring. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
 5. A bill of material which enumerates all devices associated with the control panel.
- C. Product Data: Submit catalog information and descriptive literature for components.
- D. Test Reports: Submit certified factory test report indicating control panel successfully performs functions specified.
- E. Manufacturer's Installation Instructions: Submit instructions on installation and field wiring connections.
- F. Manufacturer's Field Reports: Submit certification after installation that control panel has been installed in accordance with manufacturer's instructions and has been successfully field tested.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 19 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of control panel and final wiring diagrams and connections.

- C. Operation and Maintenance Data: Submit operation and maintenance instructions for components and devices.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with UL 508A and 698A as required.
- B. Provide components compatible with functions required to form complete working system.
- C. Provide UL 508A and or 698A label on complete assembly.
- D. Perform Work in accordance with NEC.
- E. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer and Fabricator: Company specializing in manufacturing and assembling products specified in this section with minimum three years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 13 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspect for damage.
- C. Store in areas protected from weather, moisture, or possible damage; do not store directly on ground; handle to prevent damage to wiring and components.

1.9 COORDINATION

- A. Section 01 11 13 - Administrative Requirements: Requirements for coordination.
- B. Coordinate work and component requirements with controlled pumps.

1.10 EXTRA MATERIALS

- A. Section 01 77 19 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish the following spare parts for each panel provided under this contract:

1. 6 pilot light LEDs for each tint.
2. 1 24 volt AC power supply for each size utilized.
3. 24 fuses for each type and size utilized.
4. 1 relay for each type utilized.

PART 2 - PRODUCTS

2.1 CONTROL PANEL ASSEMBLIES

- A. Acceptable manufacturers include but are not limited to:
1. ANTHC Panel shop
 2. TecPRO, Anchorage, Alaska
 3. Dowland-Bach, Anchorage, Alaska
 4. Systems Interface, Bothell Washington

2.2 GENERAL

- A. Panel construction shall conform to NFPA 70 (NEC) Article 409 and NFPA 79.
- B. The control panel controls shall be a combination of 120 & 24 VAC. Control conductors shall be provided in accordance with the indicated requirements.
- C. The control panel shall be the source of power for any 24VAC instruments or valves and their controllers interconnected with the control panel unless otherwise noted herein or on the plans. All equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.
- D. 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 interior control or relay panels mounted above ground level shall be NEMA 4X.
- E. Each source of 'external' voltage shall be isolated by providing a circuit breaker, disconnecting fused terminal blocks or DIN rail mounted relays. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. The CONTRACTOR shall provide sufficient terminal blocks as shown on the Drawings.
- F. Discrete outputs from the control panels shall be provided by electrically isolated contacts rated for 6 amps at 24 V or 5 amps at 120 VAC.
- G. All control panel mounted devices shall be provided as shown on the Drawings or called for in the specifications.

2.3 COMPONENTS

- A. General: Additional components are specified on the plans in individual component schedules.
- B. Control Panel Enclosure:
 - 1. Space is limited to that shown on the plans. Provide specified NEMA 4X non-metallic panel.
 - 2. Identify control panel components with engraved nameplate mounted on inside of panel.
 - 3. Mount components, not mounted on front of panel, on removable back panel secured to enclosure with collar studs.
 - 4. Install wiring in neat, workmanlike manner and group, bundle, support and route horizontally and vertically for neat appearance.
 - 5. Terminate wires leaving panel at terminal strips inside enclosure.
 - 6. Identify terminals and wires in accordance with panel wiring diagrams.
 - 7. Furnish copper grounding plate inside control panel for terminating ground wires.
 - 8. Manufacturer HOFFMAN A201610CHSCFGW with back plane or equal.
- C. Circuit Breakers:
 - 1. Furnish quick-make, quick-break thermal-magnetic molded case type, individually DIN rail mounted and identified.
 - 2. Furnish individual circuit breakers for each of the following:
 - a. Main Circuit Breaker
 - b. Control Circuit
 - c. Each valve served from the panel unless otherwise noted.
- D. Legend Plates for Pilot Devices:
 - 1. Furnish 2x2-1/2 inch plastic legend plate with rounded corners for each selector switch, push button and pilot light.
 - 2. Color: Gray with white lettering.
- E. Mounting of Instruments
 - 1. The panel vendor shall provide cut outs, and shall mount all instrument items indicated to be panel-mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.
 - 2. The panel vendor shall also mount behind the panels other instrument accessory items as required for functionality or as indicated.
 - 3. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal.
 - 4. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.
- F. Electrical Requirements

1. The Contractor shall provide conduit, wireways, switches, wire, and electrical fittings for all 24 V and 120 VAC circuits to instruments and other electrical devices as required for a complete and operable installation.
2. Conduit, wireways, junction boxes and fittings shall include those required between sensors and transmitters and between the junction boxes and instruments.
3. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers. Terminals shall be DIN rail mounted, rated at 120 VAC, manufactured by Phoenix Contact, Entrelec, or equal.
4. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the N.E.C. requirements for General Purpose (no open wiring) unless otherwise indicated.
5. Signal and Control Circuit Wiring
 - a. Wire type and sizes: Conductor shall be flexible stranded copper wire, UL. Wires for instrument signal circuits and alarm input circuits shall be No. 16 AWG Type MTW rated for 300 volts. The analog cables between the PLC I/O card and terminal strips shall be (8) conductor No. 18 AWG cable rated 300 volts for loop powered devices and 8-pair shielded No. 18 AWG cable rated 300 volts for 4-wire loops.
 - b. Wire Insulation Colors:
 - 1) 120 VAC Power - Black 14 AWG minimum
 - 2) 120 VAC Neutral - White 14 AWG minimum
 - 3) 120 VAC Ground - Green 14 AWG minimum
 - 4) 120 VAC Control - Red 14 AWG minimum
 - 5) 120 VAC Foreign Power - Yellow 16 AWG minimum
 - 6) 120 VAC Foreign Neutral - Yellow 16 AWG minimum
 - 7) DC Positive - Blue 16 AWG minimum
 - 8) DC Negative - White/Blue 16 AWG minimumAll 120 VAC power wiring protected by the main circuit breaker and incoming power service shall be No. 12 AWG.
 - c. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from heat shrink plastic. Wires shall be marked as shown on the Drawings. Numbers shall read from left to right.
 - d. Flexible conduit is only to be used where specified.
 - e. Conduit fittings shall be Crouse Hinds cast fittings, or equal.
 - f. For equipment grounding, panels shall be provided with a 1/4 inch by 1 inch copper ground bus complete with solder-less connector for one No. 4 AWG bare stranded copper cable. The copper cable shall be provided by the CONTRACTOR and be connected to the electrical equipment ground of the 120-volt panel supplying power.
6. Power Supply Wiring
 - a. Unless otherwise indicated, all instruments, alarm systems, and controls shall operate on 120 or 24 V circuits.
 - b. The panel fabricator shall provide terminal box connections for the main power supply entry as shown on the Drawings.
 - c. When instruments do not come equipped with integral fuses, provide fuses as required for the protection of individual instruments against fault currents. Fuses shall be mounted on the back of the panel in a fuse holder, and each fuse shall be identified by a

service name tag. Fuses shall be as manufactured by Bussmann Manufacturing Division, Type KAW TRON, or equal. Circuit breakers shall be provided as shown on the Drawings.

G. Relays:

1. Interpose and control relays shall be DIN Rail mounted ABB model RB121G-115VUC, or equal, for single pole, and RB122G-115VUC for 8-amp double pole.
2. Where specifically called for on the plans, higher current relays shall have square base with contacts rated at 10 amps, 230 volts, at 20,000 operations. The coils shall be 24VDC at 0.03 amps. Relays shall be 2, 3 or 4-pole as required with power on LED and manual override, Allen Bradley or equal.

H. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers.

I. Digital Control Terminals: Fused Terminals for the discrete input points shall be 2-wire terminal with a fused circuit and a feed through circuit. Provide a one-tenth of an ampere rapid blow 250-volt fuse for all discrete input circuits. The discrete input terminal shall be Weidmuller model KDKS 1 PE part 953245.

J. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. Wiring shall be identified with stamped tubular wire end markers. 120V terminals shall be DIN rail mounted, rated at 400 VAC, manufactured by ABB/Entelec, or equal.

K. Spare Fuses: For each panel, provide the following spare fuses:

1. A minimum of two spare fuses of each size
2. One spare fuse for every ten fused circuits

Provide the fuses in a spare fuse box mounted on the interior wall of the panel. Fuse box shall be Plano Tackle Systems 1061 Accessory Box, Plano, IL, www.planomolding.com, or equal.

L. Power Supply 24 VAC:

1. The motorized valve power shall be provided by a 24VAC source with 150VA rated output
2. Power supply shall consist of a self protected transformer.
3. Incoming 120V supply shall be protected with an integral breaker
4. Each individual 24VAC output shall be provided with an independent ON-OFF and overcurrent protection.
5. Manufacturer: RIB TR150VA002 or equal

M. Labor and Workmanship: Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

2.4 MARKING

A. Control panels shall be marked with the following information that is plainly visible after installation:

1. Manufacturer's name
2. Supply voltage
3. Short-circuit rating of the main breaker
4. Name of the project and site
5. Enclosure rating
6. Minimum Size of Control Wiring: Number 16.
7. Tag control wiring at both ends in control panel with legible permanent coded wire marking sleeve. Mark with white PVC tubing sleeves with machine printed black marking. Mark in accordance with wire numbers shown on approved shop control wiring diagrams and terminal strip numbers.

2.5 SOURCE QUALITY CONTROL AND TESTS

- A. Perform a factory test of completed control panel by demonstrating operation of control functions. Provide certified test results.
- B. Factory assemble and test each control and alarm function.

PART 3 - EXECUTION

3.1 CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

- A. Wiring Installation: All wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing out panel to components on a part of the fixed structure, and (4) wiring to panel mounted components. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.
- B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.
- C. Enclosures Wiring: Where enclosures are utilized to contain enclosed assemblies such as motor starters, contactors or enclosed breakers, all wiring shall be run in liquidtight flexible conduit (LFMC), unless otherwise noted on the Drawings. All enclosure wiring and raceways shall be installed by the panel builder in the shop.
- D. Wiring to rear terminals on panel mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.
- E. Shop Drawings shall show conformance to the above wiring installation requirements.

- F. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number as shown on the Contract Drawings. These numbers shall be marked on all conductors at every terminal.

3.2 CALIBRATION, TESTING, AND INSTRUCTION

- A. General: Calibration, testing, and instruction shall be performed in accordance with Section 40 00 00 – Process Control and Instrumentation Systems.
- B. Inspection and Approval
 - 1. Panel fabricator shall conduct the following tests prior to arrival of the Engineer or before shipment, if the Engineer chooses not to witness factory testing.
 - a. All status, control, analog and alarm circuits rung out to determine their operability.
 - b. All electrical power circuits checked for continuity and where applicable, operability.
 - c. Any other test required to place the panel in an operating condition.
 - 2. It shall be the responsibility of the Contractor to furnish all necessary testing devices and sufficient manpower to perform the tests required by the Engineer.
 - 3. Field Testing: Each control panel shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

3.3 INSTALLATION

- A. Install control panel at location indicated on Drawings.
- B. Install control panel in accordance with manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

- A. Section 01 77 19 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Start-up control system by energizing system equipment and testing operation of hardware and process control logic under supervision of manufacturer's representative and in presence of Architect/Engineer.
- C. Equipment Acceptance:
 - 1. Adjust, repair, modify or replace system components that fail to perform as specified and rerun tests. Make final adjustments to equipment under direction of manufacturer's representative.
 - 2. Document adjustments, repairs and replacements in manufacturer's field services certification.

3.5 DEMONSTRATION

- A. Section 01 77 19 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION