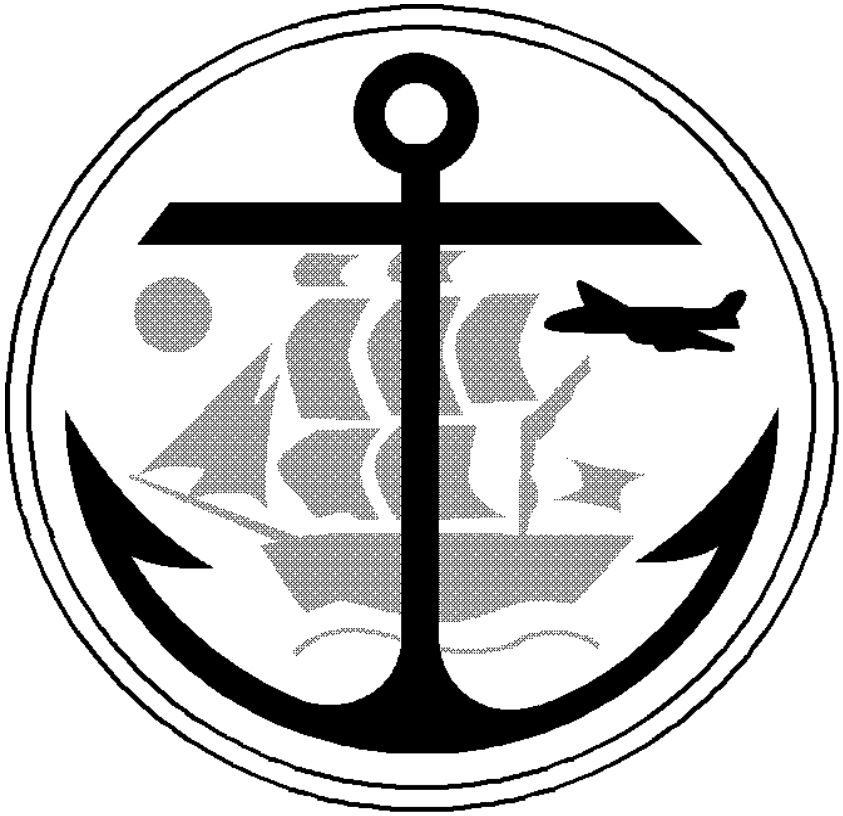
Pump Station 2 Rehabilitation

INVITATION TO BID NO. 2024C029



Municipality of Anchorage
Anchorage Water and Wastewater Utility
3000 Arctic Boulevard
Anchorage, AK 99503

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

These documents were prepared under the supervision of a registered Professional Engineer.

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

MASTER INDEX

The most current version of the Municipality of Anchorage Standard Specifications (M.A.S.S.) is provided on the Municipality website at

http://www.muni.org/departments/project_management/pages/mass.aspx.

Notifications will be sent when updates are made to the document, but each user of M.A.S.S. is responsible to verify that they are using the most current version.

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

SECTION I

INVITATION TO BID

MUNICIPALITY OF ANCHORAGE
PURCHASING DEPARTMENT

Invitation to Bid

No. 2024C029

Sealed bids will be received in accordance with the time schedule shown below by the Municipality of Anchorage at the Purchasing Department, 632 W. 6th Ave., Suite 520, Anchorage, Alaska 99501 for:

Pump Station 2 Rehabilitation

Project Consists of of the Contractor rehabilitating Pump Station 2 to include new electrical service and switchgear; new wastewater pumps and variable frequency drives; new controls; new flow meters, piping and valves; misc. building improvements; new HVAC componants; new floor grating; concrete wall crack repairs and painting; new wet well sluice gates; demolish existing pump station equipment; and other miscellaneous items of work. Additionally, the work includes providing sewer flow control for the pump station during construction.

ESTIMATED CONSTRUCTION COST: **Between: $5,000,001 - $10,000,000**

Site Visit:	**10:00 A.M. Local Time, April 17, 2024** *****THIS SITE VISIT IS MANDATORY FOR ALL BIDDERS.***** **Intersection of W. 12th Ave. & U Street; Anchorage, AK 99501**
Pre-Bid Conference:	**N/A**
Questions Due:	**12:00 P.M. Local Time, April 24, 2024**
Bid Opening:	**3:00 P.M. Local Time, May 1, 2024**

All Pre-Bid Conferences and/or Bid Openings may be attended in person or via conference call at this number (907) 343-6089. You may call in five (5) minutes before any scheduled conference. EMAILED BIDS WILL NOT BE ACCEPTED.

ALL QUESTIONS SHALL BE SUBMITTED PRIOR TO THE QUESTION DUE DATE THIS WILL BE THE FINAL OPPORTUNITY TO ASK QUESTIONS OR REQUEST CLARIFICATIONS.

Requests for interpretation or clarification of the bidding Documents shall be made in writing to the Purchasing Office (wwpur@muni.org). Please reference the Invitation to Bid Number & Project Title. Do not contact the specified department directly.

To maintain the project schedule, Interpretations, corrections, or changes to the Bidding Documents shall be made by Addendum and shall not be binding unless included in the Addendum. It is your responsibility to periodically check the website for addenda.

At the above indicated time, the bids will be opened publicly and read. Bids must be received by the Purchasing Officer prior to the time fixed for opening of the bids to be considered. Time of receipt will be as determined by the time stamp in the Purchasing Office.

The Municipality of Anchorage reserves the right to reject any and all bids and to waive any informalities in the bids. No bidder may withdraw his bid after the hour set for the opening of bids or before the award of contract unless said award is delayed for a period exceeding sixty (60) days from the time of the opening.

The Municipality shall not be responsible for bid preparation costs, nor for costs, including attorney fees, associated with any (administrative, judicial or otherwise) challenge to the determination of the lowest responsive and responsible bidder and/or award of contract, and/or rejection of bids. By submitting a bid, each bidder agrees to be bound in this respect and waives all claims to such costs and fees.

Contracts shall be awarded by written notice issued by the Purchasing Officer to the lowest responsive and responsible bidder; however, preference will be given to local bidders in compliance with Anchorage Municipal Code Section 7.20.040.

The Municipality of Anchorage assumes no responsibility for any interpretations or presentations made by any of its officers or agents unless such interpretations or presentations are made by written addendum to this Invitation to Bid.

Bonding Requirements are per MASS/MASS B or as per special provisions

THE MUNICIPALITY OF ANCHORAGE IS AN "EQUAL OPPORTUNITY EMPLOYER"

PUBLISH ONE TIME

Date: April 10, 2024

Senior Buyer Assigned to this Project:
Melanie A. Clark

Chris Hunter
Deputy Purchasing Director

Municipality of Anchorage

Anchorage Water and Wastewater Utility

2024 SEWER IMPROVEMENTS
PUMP STATION 2 REHABILITATION

SECTION II

SPECIAL PROVISIONS

Municipality of Anchorage

Anchorage Water and Wastewater Utility

2024 SEWER IMPROVEMENTS

PUMP STATION 2 REHABILITATION

INDEX TO THE SPECIAL PROVISIONS

GENERAL PROVISIONS

GENERAL STATEMENT AND EXTENT OF WORK

All proposed Work for the Pump Station 2 Rehabilitation Project is located in Anchorage, Alaska, as shown on the Drawings. The Work included in this Contract consists of furnishing all labor, equipment, materials, supervision, and other facilities necessary to complete the Work set forth in the Plans, Specifications, and terms of the Contract successfully.

The Work that is presented in the Bid Proposal for this Contract consists of the Contractor rehabilitating Pump Station 2 to include new electrical service and switchgear; new wastewater pumps and variable frequency drives; new controls; new flow meters, piping, and valves; misc. building improvements; new HVAC components; new floor grating; concrete wall crack repairs and painting; new wet well sluice gates; demolish existing pump station equipment; and other miscellaneous items of work. Additionally, the Work includes providing sewer flow control for the pump station during construction.

It shall be the responsibility of the bidder to prepare the bid so that all materials and working arrangements harmoniously conform to the intent of the Contract Specifications and Special Provisions.

SPECIFICATIONS, CODES, ORDINANCES, AND STANDARDS

The Contractor shall perform all Work in accordance with the Contract Documents which include the most current edition of the **Municipality of Anchorage Standard Specifications**, (hereinafter referred to as M.A.S.S.), and herein revised and supplemented as the Special Provisions.

The Contractor shall perform all Work in accordance with the latest edition of all applicable codes, ordinances, standards, and associated addenda including the AWWU Design and Construction Practices Manual (hereinafter referred to as D.C.P.M.).

The M.A.S.S. and D.C.P.M. are available for download at the following links:

M.A.S.S.
http://www.muni.org/departments/project_management/pages/mass.aspx

D.C.P.M.
https://www.awwu.biz/about-us/reliable-infrastructure/design-and-construction-practices-manual

CHANGES TO THE MUNICIPALITY OF ANCHORAGE STANDARD SPECIFICATIONS (MASS)

The following enumerated provisions of MASS are amended as hereinafter stated.

DIVISION 10 STANDARD GENERAL PROVISIONS

SECTION 10.01 DEFINITIONS

Add the following item to the list of definitions:

Record Drawings – Detailed drawings that accurately depict all changes in location (both horizontal and vertical), material, equipment, and other elements of Work accomplished by the Contractor. The drawings shall also depict the horizontal and vertical locations of all other utilities and obstructions encountered during construction. Final elevations and locations shall be clearly marked with actual dimensions.

SECTION 10.03 AWARD AND EXECUTION OF CONTRACT

Article 3.2 Receipt and Opening of Bids

Delete in their entirety paragraphs two (2) and four (4).

Article 3.7 Contractor's Warranty

Delete the first sentence of the first paragraph and replace with the following:

The Contractor shall warranty all materials and workmanship for two (2) years from the Final Acceptance Date.

SECTION 10.04 SCOPE OF WORK

Article 4.8 Work Incidental to the Contract

Delete the numbered item thirteen and replace with the following:

13. Securing, permitting, maintaining, and restoring a stockpile/materials staging area as necessary to complete the Work.
14. All Work required to shore, remove, and/or reset light poles and luminaires, including coordinating with Chugach Electric Association.
15. All Work required to shore, remove, and/or reset gas utility amenities including coordinating with Enstar Natural Gas Company.
16. All Work required to shore and protect in place AC and GCI utility amenities including coordinating with the utility.
17. Protecting trees from removal.
18. Tack Coat.
19. Removing and resetting gardens, planters, landscaping, retaining walls, gates, fencing, play equipment, and other on-property improvements and personal property in all areas disturbed by the Work.
20. Trench shoring, including the use of a portable trench box.
21. Preserving, protecting, and replacing all monuments and lot corners.
22. Removal and disposal of all sewer utility amenities to be removed.
23. Connections to existing items specified in the Contract Documents. This includes but not limited to items specified in the Contract Documents as furnish

and install pipe connecting to existing pipe, connecting existing pipe to sanitary sewer manhole, etc.

24. Providing weekly Construction Progress Schedules and attending weekly progress meetings.
25. Other items indicated on the Drawings or in these Specifications, but not specifically listed as a bid item in these Contract Documents.

Article 4.12 Public Convenience and Access

Delete the second sentence of the first paragraph and replace with the following:
Without prior approval of the Engineer, entrances or driveways of all kinds shall not be blocked for more than eight (8) hours.

Article 4.13 Traffic Control Plan

Replace the paragraphs five (5) and six (6) with the following:
The Contractor is responsible for obtaining all road closure permits and for complying with all requirements of those permits. Full payment for project traffic control shall be made through bid item entitled "Traffic Maintenance." No other separate payment shall be made.

Add the following paragraph to the end of the Article:
The Contractor shall prepare and submit six (6) copies of an acceptable Traffic Control Plan (TCP) to be employed during construction. The TCP shall be delivered to the Engineer within ten (10) working days of the effective date of the Notice-To-Proceed or five (5) working days before the commencement of Work, whichever is the earlier date. The Engineer will review and accept or reject the plan within five (5) working days of submission. Successive submittals will also be reviewed within five (5) working days. The review by the Engineer is separate from any other agency review.

Article 4.17 Utilities

Add the following after the sixth paragraph:
Allowances for work performed by Utility Companies are shown as an item on the Bid Proposal. Any invoices for the Work shall be paid by the Contractor and reimbursed through the utility allowances. Contractor shall provide copies of invoices to the Engineer, and no markup shall be allowed. Contractor is responsible for coordination with the Utility Companies. All costs for coordination and management are incidental to the Work.

Add the following sentence to the end of the seventh paragraph:
Utility locates are the responsibility of the Contractor to request, coordinate with the Work, maintain, and protect.

Replace the list of Utility Companies in Article 4.17 E with the following:

Alaska Communication Systems (ACS) North ANC – Francisco Martin, 564-1785 or 231-7369

Alaska Communication Systems (ACS) South ANC – Duilio Guerrero, 564-1522

Anchorage Water & Wastewater Utility (AWWU) – Shawn Dooley, 564-2786

AT&T – Mike Barsalou, 264-7325

Chugach Electric Association (CEA) – Victor Willis, 230-7536

ENSTAR Natural Gas – Stan Staples, 334-7777

GCI – Steven Cranford, 868-6769

Municipal Street and Storm Drain Maintenance – Eric Hodgson, 343-8100

Municipal Street Light Maintenance – Eric Hodgson, 343-8100

Municipal Traffic Signals Section – Mike Sickler, 343-8355

Solid Waste Services (SWS) – Evalu Filitaula, 343-6258 or 317-6863

Matanuska Electric Association (MEA) – John Foutz, 761-9265

Matanuska Telephone Assoc. (MTA) – Robbie Nash, 761-2704 or 355-1687

Eagle River Street & Storm Drain Maintenance – Mark Littlefield, 343-1512

Alaska Waste – Josh James, 688-4446

Add the following new Articles:

Article 4.22 Responsibility of Contractor to Act in Emergency

In case of an emergency that threatens loss and/or injury of property and/or safety of life, the Contractor shall act, without previous instructions from the Engineer, as the situation may warrant. The Contractor shall notify the Engineer thereof immediately thereafter. Any claim for compensation by the Contractor, together with substantiating documents in regard to expense, shall be submitted to the Owner through the Engineer. The amount of compensation shall be determined by agreement.

The Contractor shall supply the Engineer, prior to commencement of Work, with an emergency telephone number through which a responsible Contractor's representative can be contacted on a twenty-four (24) hour a day basis.

Article 4.23 Daily Progress Reports

The Contractor shall submit daily progress reports to the Engineer. The reports for the current workweek shall be submitted no later than the following Monday by 12:00 p.m. The development, preparation, and presentation of all daily progress reports are incidental to the Contract and no separate payment shall be made. Each daily report shall include:

1. Names and hours worked for all personnel on site, including personnel for all subcontractors.
2. Construction equipment on hand, including utility vehicles such as pickup trucks, maintenance vehicles, etc.
3. Documentation of weather conditions and any resulting impacts to the Work.
4. General progress of the Work, including a list of activities started and completed, mobilization and demobilization of subcontractors, and major milestones achieved.

5. Contractor's plan for management of site (e.g., lay down and staging areas, construction traffic, etc.), utilization of construction equipment, buildup of trade labor, and identification of potential Contract changes.
6. Identification of new activities and sequences as a result of executed Contract changes (if any).
7. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
8. Changes to activity logic.
9. Changes to the critical path.
10. Identification of, and accompanying reason for, any activities added or deleted since the last report.
11. Steps taken to recover the schedule from Contractor caused delays.

Article 4.24 Coordination with Other Projects

It shall be the responsibility of the Contractor to coordinate with and minimize impact to other projects.

The Contractor is responsible for affirmatively coordinating with other projects so as to not unreasonably interfere with the performance of the other projects.

If the Work of the Contractor is delayed or disrupted because of the construction or transportation activities of other projects, the Contractor is not entitled to additional compensation from the Owner, but may be entitled to an extension of time in accordance with Article 5.23 – Delays and Extension of Time.

Except with regard to a possible entitlement to an extension of time, the Contractor must hold harmless, defend, and indemnify the Owner from and against any and all claims by the Contractor arising directly or otherwise out of the other projects.

Work required to coordinate with and minimize impact to other work in the Project area will be considered incidental to the Project.

SECTION 10.05 CONTROL OF WORK

Article 5.3 Construction Progress Schedule and Schedule of Values

Replace the last sentence of the first paragraph:
The Construction Progress Schedule shall be revised and resubmitted to the Engineer at weekly project status meetings. The Contractor shall be required to attend the weekly meetings. Meeting participation and attendance is incidental to the contract and no separate payment shall be made.

Add the following paragraphs after the second paragraph:
The Contractor shall also deliver, at the same time as the Construction Progress Schedule, in a form satisfactory to the Engineer, a Schedule of Values detailing the costs of providing all labor, equipment, supplies, transportation, handling, and disposal in connection with the removal of system plant infrastructure as listed in the table below.

Plant system category	Plant system subcategory
Wastewater collection plant	• Gravity sewer main (size) • Sewer force main (size) • Manhole (type) • Cleanout
Sewer pumping plant	• Pump station structure and improvements • Pump station wells • Electric pumping equipment
General plant	• Structures and improvements

Work items not listed in a subcategory shall be incidental to the subcategory item.

A. Schedule of values format and content:

1. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
    a. Related specification section or division.
    b. Description of Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change orders (numbers) that affect value.
    g. Dollar value (percentage of contract sum to nearest percent, adjusted to total 100 percent).
2. Provide a breakdown of the contract sum in sufficient detail to facilitate continued evaluation of applications for payment and progress reports. Coordinate with the project manual table of contents. Break principal subcontract amounts down into several line items.
3. Round amounts to nearest whole dollar. The total shall equal the contract sum.
4. Provide a separate line item in the schedule of values for each part of the Work where applications for payment may include materials or equipment, purchased or fabricated and stored, but not yet installed.
    a. Differentiate between items stored on-site and items stored off-site. Include requirements for insurance and bonded warehousing, if required.
5. Provide separate line items on the schedule of values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
6. Margins of cost: Show line items for indirect costs and margins on actual costs only when such items are listed individually in applications for payment. Each item in the schedule of values and applications for payment shall be complete.

Include the total cost and proportionate share of general overhead and profit margin for each item.

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

7. Schedule updating: Update and resubmit the schedule of values prior to the next applications for payment when Change Orders or construction change directives result in a change in the contract sum.

Article 5.4 Non-Working Hours, Holidays, Saturdays, and Sundays

Replace the first sentence of the first paragraph:
The Contractor shall give the Engineer seventy-two (72) hours advance notice of his intention to work overtime, Saturdays, nights, Sundays or holidays, or any time outside the usual working hours.

Add the following sentence to the end of the last paragraph:
A standard workday is a ten (10) hour workday (excluding meal times) within the timeframe of no earlier than 7:00 a.m. and no later than 7:00 p.m.

Article 5.22 Time for Completion of Work

Add the following sentence to the end of the first paragraph:
The Contractor shall substantially complete the work under this Contract within four hundred and ninety (490) calendar days of the effective date of the "Notice to Proceed".

The Contractor shall complete all work under this Contract within five hundred and forty-six (546) calendar days of the effective date of the "Notice to Proceed".

Article 5.27 Liquidated Damages

Delete the first two sentences of the first paragraph and replace with the following:
The Owner may deduct out of any progress payment the sum of Five Hundred Dollars ($500.00) per day as Liquidated Damages for each and every calendar day that the Substantial Completion Date is delayed beyond the Substantial Completion Date specified in Article 5.22, Time for Completion of Work. The Owner may deduct out of any progress payment the sum of Two Hundred Fifty Dollars ($250.00) per day as Liquidated Damages for each and every calendar day that the Final Acceptance Date is delayed beyond the Contract Completion Date.

Add the following Articles:

Article 5.34 Work Plan

Contractor shall prepare a Work Plan for approval by the Engineer prior to beginning construction. The goals of the Work Plan shall include the following:

1. Minimize impacts to vehicular and pedestrian traffic.
2. Maintain a safe transportation corridor through the project area for vehicles and pedestrians.
3. Minimize disruption of vehicular parking for local residents.

4. Minimize dust and erosion generated by Construction activities.
5. Minimize overall construction noise.

Contractor shall submit the project Work Plan for approval by the Engineer within 7 days after signature of the Contract. Contractor shall coordinate the Work Plan with the Traffic Control Plan. Work shall not proceed until the Engineer has approved, in writing, the Work Plan. The Work Plan shall include estimated dates of completion for each Work Phase.

No separate payment shall be made for the Work described in this Article and all Work required providing an approved Work Plan is incidental to the Contract.

Article 5.35 Project Meetings

The Engineer will schedule once-per-week project meetings at a time and location determined by the Engineer. The Contractor's Project Manager, it's Field Superintendent, and Subcontractors, as requested, shall attend the meetings with the Owner, its Representative, Engineer, and Inspector.

SECTION 10.06 LEGAL RELATIONS AND RESPONSIBILITIES

Article 6.1 Laws to be Observed

Add the following after the first paragraph:
Owner is not aware of any contaminated material within the project limits. If such material is encountered, Contractor shall notify the Engineer immediately for direction. This will be treated as a changed condition, unless the contamination was caused by Contractor's operation.

Article 6.6 Permits

Add the following sentence to the end of the sixth paragraph:
The Contractor shall identify the "Anchorage Water and Wastewater Utility" as the applicant on any permit application forms.

Article 6.9 Insurance

Remove and replace the fifth sentence of the first paragraph with the following:
The insurance company must provide written notification to the MOA contract administrator of any material change, cancellation, or non-renewal of the insurance policies. If the insurer does not notify the MOA in these circumstances, it will be the contractor's responsibility to make that notification.

SECTION 10.07 MEASUREMENT AND PAYMENT

Article 7.5 Progress Payments

Delete the fourth sentence of the first paragraph and replace with the following:
The Owner shall process Partial Payment Estimates and make payment to the Contractor within fifteen (15) days of execution of all signatures required on the Partial Payment Estimate.

Add the following paragraphs after the second paragraph:
A. Applications for payment

1. Each application for payment shall be consistent with previous applications and payments as certified by the Owner's representative and paid for by the Owner.
    a. The initial application for payment, the application for payment at time of Substantial Completion, and the final application for payment involve additional requirements.
2. Application preparation: Complete every entry on the form. Include notarization and execution by a person authorized to sign legal documents on behalf of the Contractor.
    a. Entries shall match data on the schedule of values and the Contractor's construction schedule. Use updated schedules if revisions were made.
    b. Include amounts of Change Orders and construction change directives issued prior to the last day of the construction period covered by the application.
3. Transmittal: Submit one (1) signed and notarized original copy of each application for payment to the Owner's representative by a method ensuring receipt within twenty-four (24) hours. One copy shall be complete, including OEO reports and similar attachments, when required.
    a. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application, in a manner acceptable to the Engineer.
4. Initial application for payment: Administrative actions and submittals, that must precede or coincide with submittal of the first application for payment, include the following:
    a. List of subcontractors.
    b. List of principal suppliers and fabricators.
    c. Schedule of values.
    d. Contractor's construction schedule (preliminary if not final).
    e. Schedule of principal products.
    f. Schedule of unit prices.
    g. Submittal schedule (preliminary if not final).
    h. List of Contractor's staff assignments.
    i. List of Contractor's principal consultants.
    j. Copies of permits.
    k. Initial progress report.
5. Application for payment during construction.
    a. Progress Redlines shall be submitted with each application for payment.

6. Application for payment at substantial completion: Submit an application for payment following issuance of substantial completion.
    a. This application shall reflect certificates of partial substantial completion issued previously for Owner occupancy of designated portions of the Work.
    b. Administrative actions and submittals that shall precede or coincide with this application include:
        i. Occupancy permits and similar approvals.
        ii. Warranties (guarantees) and maintenance agreements.
        iii. Maintenance instructions.
        iv. Changeover information related to Owner's occupancy, use, operation, and maintenance.
        v. Final cleaning.
        vi. List of incomplete Work, recognized as exceptions to Engineer's issuance of substantial completion.

Contractor shall submit, with the first application for payment, a copy of the Notice of Work executed by the State Department of Labor, Wage & Hour Administration. Failure to submit a copy of this form with the first application for payment will result in the withholding of $5,000 from the progress payment. Additionally, a filing may be issued to the Wage & Hour Administration for failure to provide such notice.

Add the following to the list of Withholdings, in the fourth paragraph, and renumber the previous six (6) through eight (8) as nine (9) through eleven (11):

6. Failure to submit the detailed Schedule of Values consisting of several elements as required. (The Engineer cannot pay on any of the items specified to be broken down until the breakdown is received and accepted).
7. A maximum of $5,000 for failure to provide a Notice of Work and/or a Notice of Completion as required by Alaska Statute 36.05.045. For final payments, the difference between $5,000 and the actual amount paid for the Notice of Work filing shall be withheld until such time as the Contractor provides a copy of the Notice of Completion executed by the Wage & Hour Administration to the Engineer.
8. The value of items missing by the contract documents. Examples include, but are not limited to, record drawings; operations and maintenance manuals; Department of Labor Notice of Work and/or Notice of Completion, ADEC Notice of Completion form, or other items as listed in the schedule of values or elsewhere required in the contract documents.

Add the following sentence to the end of the list of withholdings:
Monies withheld under Article 7.5 - Progress Payments, shall be paid to the Contractor by subsequent pay estimates that follow the date on which the Contractor satisfactorily corrects the deficiencies causing the withholding.

Delete the fifth paragraph and replace with the following:
The amount of any withholding for items one (1) through eight (8) above shall be the reasonable value of the Work or remedy to be accomplished as estimated by the Engineer, without regard to bid amount of cost to the Contractor. The amount of withholding for items nine (9) through eleven (11) shall be in accordance with the claimed amount or the applicable Contract provisions.

Add the following paragraph to the end of the Article:
The monthly pay estimate shall be computed on the basis of Work completed. All quantities shall be subject to review by the Engineer prior to approval for payment. Monthly price allocation for payment of lump sum items shall be based on the approved construction progress schedule and schedule of values.

The State of Alaska funds this Contract (in part); therefore, the provisions of Alaska Statute 36, Section 36.90, and Article 3 entitled "Public Construction Contract Payment" apply.

Article 7.7 Final Payment

Add the following paragraphs after the first paragraph:
Additional administrative actions and submittals that must precede or coincide with submittal of the final application for payment include the following:

1. Evidence of completion of project closeout requirements.
2. Completion of items specified for completion after substantial completion and all applicable punchlist(s) from the Engineer.
3. Proof that incomplete Work has been completed and accepted by the Owner.
4. Transmittal of required project construction records to the Owner's representative.
5. Removal of temporary facilities and services, surplus materials, rubbish, and similar elements.
6. Change of door and gate locks to Owner.
7. Approved redlines for record drawings.

Article 7.8 Correction of Work after Final Acceptance Date

Delete the first sentence of the first paragraph and replace with the following:
Placement of the Project on warranty shall not relieve the Contractor of his responsibility for paying all costs resulting from defects in materials or workmanship supplied under the terms of the Contract, and for correction of those defects, for a period of two (2) years following the Final Acceptance Date.

SECTION 10.08 FORMS

Delete this Section. All forms required for this Project are provided in Section IV of the Contract Documents.

DIVISION 20 EARTHWORK

SECTION 20.05 CLEARING

Article 5.2 Construction

Add the following paragraph:
The Contractor shall protect migratory bird habitat in compliance with the most current version of the "Construction Advisory for Protecting Migratory Birds (pdf)" handout located at https://www.fws.gov/alaska/mbsp/mbm/index.htm. Additionally, Contractor shall notify the Engineer immediately if any active nests are found at any time during construction of the project.

SECTION 20.09 REMOVAL OF PAVEMENT

Article 9.2 Construction

Delete the second paragraph and replace with the following:
Contractor shall keep pavement that is designated for removal free from objectionable material (concrete, steel, etc.) and shall dispose of pavement designated for removal at the Kloep Maintenance Station, 5701 Northwood Street. Contractor shall coordinate exact location and time of delivery with Paul VanLandingham at 343-8372 or 317-7054 with MOA Street Maintenance. If the removed pavement material under this Section contains objectionable material, as identified by the Engineer, then Contractor shall dispose of this material in accordance with Division 10, Section 10.04, Article 4.9 – Disposal Sites.

SECTION 20.12 DEWATERING

Article 12.3 Construction

Add the following paragraph to the end of the Article:
Trench dewatering shall be required to protect adjacent utilities and property and to install the new utility lines successfully. The Contractor shall provide copies of any and all dewatering permits and approvals to the Engineer.

Article 12.4 Measurement

Delete this Article and replace with the following:
No measurement will be made for Work in this Section.

Article 12.5 Basis of Payment

Delete this Article and replace with the following:
No separate payment will be made for Work in this Section. All Work associated with Dewatering will be considered incidental to the Contract.

SECTION 20.27 DISPOSAL OF UNUSABLE OR SURPLUS MATERIAL

Article 27.2 Construction

Add the following paragraph to the end of the Article:
If asbestos-cement pipe is encountered and has to be removed from the trench and disposed of, the Contractor is hereby notified that Federal regulations governing the

removal and disposal of asbestos are NESHAP 40 CFR, Part 61, Subpart M, and OSHA 29 CFR 1910. The Alaska Department of Environmental Conservation requirements include, but are not limited to 18 AAC 50, Air Quality Control Regulations, and 18 AAC 60, Solid Waste Management Regulations. The Alaska Department of Labor governing regulations include, but are not limited to Occupational Safety and Health Standard, Subchapter 04.0103: Asbestos; 8 AAC 61.600.790 Article 8; and Alaska Workers Right to Know, AS 18.60. Asbestos-cement pipe removed from the trench must be handled and disposed in accordance with the applicable Federal and State regulations. Asbestos-cement pipe must be disposed of and declared at the Hiland Road Municipal Landfill.

Article 27.4 Measurement

Add the following paragraph to the end of the Article:
No measurement will be made for the removal, handling, and disposal of asbestos-cement pipe.

Article 27.5 Basis of Payment

Add the following paragraph to the end of the Article:
No separate payment will be made for the removal, handling, and disposal of asbestos-cement pipe. All Work associated with the removal, handling, and disposal of asbestos-cement pipe will be considered incidental to the Contract.

SECTION 20.30 SHORING, SHEETING AND BRACING/SHORING AND SHEETING LEFT IN THE TRENCH AND PORTABLE

Article 30.1 General

Add the following at the end of the Article:
The Work under this Section also includes all operations necessary to shore, brace and protect from harm existing utilities located within the project area. Utilities include underground facilities as well as overhead facilities, utility poles, supporting structures and street lights.

It is the Contractor's responsibility to furnish, install, and maintain wood sheeting, steel sheet piling, shoring, planking, and bracing, whether or not indicated on the Drawings, to prevent earth movement which could damage, but not limited to, adjacent structures and/or property, landscaping, obstruct surface drainage channels or waterways, or otherwise impair or delay the work or endanger human life.

Where the centerline of any excavation is within 10 feet of any structure (including but not limited to buildings and retaining walls) in any direction, or the excavation will impact the pressure prism of the adjacent structure foundation, the Contractor shall provide shoring to protect the foundations of the structure.

Where connections of new sewer lines to existing sewer lines are located within 8 feet of the face of the structure, or the excavation will impact the pressure prism of the adjacent structure foundation, provide shoring parallel to the face of the structure over the entire width of the excavation.

Contractor shall be responsible to repair or replace any portion of any, but not limited to, structures and/or property, landscaping, surface drainage channels or waterways damaged during construction.

A. Measurement to Quantify Structure Settlement

Prior to beginning excavation, the Contractor shall obtain horizontal and elevation survey data for all structural foundation corners for structures within 10 feet of excavation. Structural corners shall include all buildings and retaining walls. The Contractor shall also survey an intermediary point when the structure length or the building wall length exceeds 50 feet. The Contractor shall set PK nails (or approved equal) into the structure to conduct the survey. The Contractor shall provide the Engineer with 24 hours of written notice prior to conducting the survey. The Contractor shall remove targets and restore building surface upon written directive from the Engineer.

Repeat measurements before final completion but after substantial completion. Measurements to be on project horizontal and vertical datum, accuracy 0.01 feet (1/8-inch). Provide daily measurements if signs of settlement are identified.

Submit measurements in table form with point designations, initial locations, subsequent measured locations, dates of each measurement, and differential from original measurement. All survey and submittals shall meet the requirements of Section 65.01 and Section 65.02.

Article 30.3 Construction

Add the following sentence to the end of the second paragraph:
No bracing requiring driven or vibratory installation methods shall be used on this Project.

Add the following to the end of the Article:
Shoring within the building foundation pressure prism will remain in place to a level one (1) foot above pressure prism. Shoring above this level may be cut off and removed. Do not cut off or remove more shoring than can be completely backfilled within same workday. Bracing may be removed when bracing is not deemed necessary for shoring stability. Ensure bracing removal allows for compaction of soils around bracing. Do not use portable trench to shore building foundations.

The shoring shall be sufficient to avoid impacting areas or facilities outside of the existing ROW, PUEs or TCPs. Methods and materials used to shore or brace utilities shall be reviewed and approved by the affected utility company before it is submitted to the Engineer for approval.

The Contractor shall prepare and submit to the Engineer for approval a Shoring Plan. The Shoring Plan shall be submitted a minimum of three (3) days prior to work involving shoring. The Shoring Plan shall detail the methods and materials to be used for trench shoring as well as utility pole shoring, if necessary. The Plan shall be prepared by and sealed by a Professional Engineer registered in the State of Alaska.

When, in the opinion of the Engineer or affected utility company, shoring is inadequate, improper, or conditions exist such that damage may occur, the Contractor shall be notified in writing by the Engineer. Such notification shall be accompanied by a statement of

corrective action. If the Contractor fails to promptly comply with such instruction, the Engineer may suspend any or all Work on the project until satisfactory, corrective action is taken. Notification or lack of notification shall in no way relieve the Contractor of the responsibilities established in Section 10.04 Subsection 4.17 Utilities.

Article 30.5 Basis of Payment

Delete the text of this Article and replace with the following:
No separate payment will be made for Work in this Section. Any single technique or combination of techniques used for Shoring, Sheeting, and Bracing; Shoring and sheeting in the Trench; and Portable Steel Shield will be considered incidental to the items in the Bid Proposal.

DIVISION 40 ASPHALT SURFACING

SECTION 40.04 TACK COAT

Article 4.5 Measurement

Delete this Article in its entirety and replace with the following:
Tack Coat shall not be measured as it is considered incidental to Pay Item 40.06 A.C. Pavement.

Article 4.6 Basis of Payment

Delete this Article in its entirety and replace with the following:
No separate payment shall be made for Tack Coat as it shall be incidental to the Contract.

DIVISION 50 SANITARY SEWERS

SECTION 50.05 SANITARY SEWER FLOW CONTROL

Delete Section 50.05 in its entirety and replace with the following:

Article 5.1 General

The Work under this Section consists of providing all labor, equipment, materials, planning, coordination, operations, permits, and facilities for sewer flow control as required to construct the Pump Station 2 Rehabilitation Project.

Refer to Part III Technical Specifications for additional CSI format specifications. If a specific work item is not listed in the Technical Specifications, reference MASS for the applicable section.

Article 5.2 Submittals

Submittals shall be as required in Part III Technical Specifications, Section 33 01 30 – Sanitary Sewer Flow Control.

Article 5.3 Materials

Materials shall be as required in Part III Technical Specifications, Section 33 01 30 – Sanitary Sewer Flow Control.

Article 5.4 Construction

Construction shall be as required in Part III Technical Specifications, Section 33 01 30 – Sanitary Sewer Flow Control.

Article 5.5 Measurement

Measurement for sewer flow control shall be by lump sum and shall consist of all labor, materials, and equipment required to complete the work as shown on the Drawings and described herein.

Article 5.6 Basis of Payment

Payment for this Work shall be in accordance with Division 10 Standard General Provisions, Section 10.07, Measurement and Payment, and shall include full payment for all Work described in this Section.

Unless specifically identified for payment under a separate bid item, the unit price bid for Sewer Flow Control shall include all labor, equipment, and materials necessary to provide sewer flow control, including connections, piping, valves, plugs, pumps, controls, fuel, fuel storage, 24-hour maintenance and inspection of sewer flow control, and removing and replacing manhole frame and covers, top riser sections, and/or top slabs.

Traffic maintenance and rerouting the Coastal Trail shall be paid for under Section 50.09 Pump Station 2 Rehabilitation.

Payment shall be made under the following unit:

ITEM	UNIT
Sewer Flow Control	Lump Sum

Add the following new Section:

SECTION 50.09 PUMP STATION 2 REHABILITATION

Article 9.1 General

The Work under this Section consists of providing all labor, equipment, and materials required to construct the Pump Station 2 rehabilitation as shown on the Drawings and described herein. The Work includes:

- New 480V electrical service to the facility
- New electrical switchgear
- New submersible wastewater pumps mounted in dry pit
- New variable frequency drives (VFD's)
- New controls
- New flow meters
- New piping and valves
- Misc. building improvements
- New HVAC
- New floor grating
- Interior concrete wall cracks repair and painting
- New wet well sluice gates
- Miscellaneous life safety improvements
- Demolish existing equipment

Technical specifications for the Work utilize a combination of MASS and CSI format specifications.

Refer to Part III Technical Specifications for additional CSI format specifications. If a specific work item is not listed in the Technical Specifications, reference MASS for the applicable section.

AWWU personnel shall have first rights to salvage any and all materials removed from the pump station. Contractor shall coordinate with AWWU to have a representative on-site after removal, but prior to disposal of removed infrastructure. All components designated for salvage by AWWU shall be placed in a secure on-site location to await removal by AWWU personnel. All other materials shall be disposed of in accordance with Section 20.13 Disposal of Unusable or Surplus Material.

The following items will be salvaged by AWWU: existing pump motor starters and the Flygt wastewater pumps. The existing generator will not be salvaged by AWWU.

Article 9.2 Quality Assurance

A. System shall comply with the standards established by OSHA, EPA and NEC for wastewater pump system installation.

B. Codes: Perform all work in strict accordance with all applicable national, state, and local codes including, but not limited to, the latest legally enacted editions of the following codes, including local adopted amendments and provisions:

1. International Building Code - IBC
2. International Fire Code - IFC
3. International Mechanical Code - IMC
4. National Electric Code - NEC
5. Uniform Plumbing Code - UPC
6. NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities

C. Standards: Reference to the following standards infers that installation, equipment, and materials shall be within the limits for which it was designed, tested, and approved, in conformance with the current publications and standards of the following organizations:

1. American National Standards Institute - ANSI
2. American Society for Testing and Materials - ASTM
3. Factory Mutual - FM
4. Institute of Electrical and Electronics Engineers - IEEE
5. National Electrical Contractors Association - NECA
6. National Electrical Manufacturers' Association - NEMA
7. Underwriters Laboratory - UL
8. National Fire Protection Association - NFPA
9. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
10. American Society of Civil Engineers (ASCE) 7-10

D. Provide manufacturer's certificates of proper installation and performance.

E. Submittals: In addition to requirements specified elsewhere, provide the following data prior to panel fabrication:

1. Bill of materials.
2. Cut sheets for all components with Manufacturer's data.
3. Provide fuse/circuit breaker sizes coordinated with actual installation (sizes shown on the drawing are nominal).

Article 9.3 Shop Drawings, Product Data, and Manufacturer's Instructions

A. Shop Drawings

1. Basic requirements for Shop Drawings are identified in Section 10.05 Control of Work, Article 5.5 Shop Drawings.
2. Minimum sheet size shall be 8-1/2 inches x 11 inches. Identify each element of the Shop Drawings by reference to drawing numbers or specification section.

B. Product Data

1. Basic requirements for Product Data are identified in Section 10.05 Control of Work, Article 5.6 Product Data.

C. Manufacturer's Instructions

1. Provide manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, balancing and finishing of material and equipment.

Article 9.4 Project Record Drawings

Maintain Record Drawings as specified in Section 10.04 Scope of Work, Article 4.19 Record Documents.

Article 9.5 Spare Parts

Provide quantities of products, spare parts, maintenance tools, and maintenance materials specified in each specification section. In general, some individual equipment specifications call for the submittal of a manufacturer's recommended spare parts list and list of spare parts sources.

Article 9.6 Materials

Materials shall be new and conform to the details shown on the Drawings and as specified herein.

A. General: All materials incorporated into the project shall be new and of recent manufacture. Materials manufactured more than 18 months prior to date of issuance of NTP shall not be used.

B. See Part III Technical Specifications for additional materials specifications.

Article 9.7 Construction

A. Coordinate with utility companies in accordance with Section 10.04 Scope of Work, Article 4.17 Utilities.

B. Prepare, implement, and maintain a SWPPP in accordance with Section 20.02 Storm Water Pollution Prevention Plan.

C. Prepare a Traffic Control Plan and provide traffic maintenance for the work crossing the Coastal Trail in accordance with MASS Section 70.12 Traffic Maintenance, including construction of Coastal Trail detour.

D. Provide any necessary clearing and grubbing in accordance with Section 20.04 Clearing and Grubbing.

E. Provide all necessary trench excavation, backfill, and compaction in accordance with Section 20.13 Trench Excavation and Backfill. Provide all necessary dewatering in accordance with Section 20.12 Dewatering.

F. Remove and replace existing asphalt pavement for the Coastal Trail in accordance with Section 40.11 Remove and Replace Asphalt Surfacing.

G. Furnish and install topsoil and seeding for all areas disturbed by construction activities in accordance with Section 75.03 Topsoil and Section 75.04 Seeding.

H. Remove and dispose of existing Pump Station 2 equipment as shown on the Drawings in accordance with Section 20.27 Disposal of Unusable or Surplus Material. Pump station components contaminated with wastewater that are removed as part of this project shall be treated like cesspools, privy pits or septic tanks and disposed of at the Municipal Landfill in accordance with MASS Section 20.27 Disposal of Unusable or Surplus Material.

I. See Part III Technical Specifications for additional construction specifications.

Article 9.8 Start-up

A. Correct all defects or defective equipment found during start-up at no expense to AWWU.

B. Start-up and maintenance instruction shall be provided by the Contractor after all new equipment has been installed, field tested, and accepted and after the facility has been placed in regular service.

C. Additional startup requirements may be found in Chapter III Technical Specifications, Division 26.

Article 9.9 Operations and Maintenance Data

A. O&M Manuals shall be in accordance with Article 10.4.20 Operating and Maintenance Manuals.

B. Contractor shall compile an individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components and subunits.

1. Contractor shall complete a Maximo Equipment Summary Form as shown in Section XVIII – Maximo Asset Reports for each piece of equipment listed with a Maximo Asset ID on the Drawings. Contractor shall use DCPM as a reference tool and guide for filling out the Maximo Equipment Summary forms. Forms shall be submitted on 8.5-inch by 11-inch paper and shall be completed either by electronic entry or handwritten.

2. Describe maintenance requirements, including routine procedures, a guide to troubleshooting, disassembly, repair, re-assembly, adjusting, balancing and checking instructions. In addition, provide the following information:

   i. Manufacturer's printed operation and maintenance instructions.

   ii. Sequence of operation by controls manufacturer.

   iii. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required to perform maintenance.

iv. Detailed lubrication instruction and diagrams showing points to be greased or oiled; recommended type, grade, and temperature range of lubricants and frequency of lubrication for each piece of equipment on the summary forms.

3. Recommended Spare Parts:

   i. Data shall be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.

   ii. "Unit" is the unit of measure for ordering the part

   iii. "Quantity" is the number of units recommended.

   iv. "Unit Cost" is the current purchase price.

4. Content for each Electric or Electronic Item or System shall include a description of the Unit and Component Parts including:

   i. Function, normal operation characteristics, and limiting conditions.

   ii. Performance curve, engineering data, nameplate data, and test results.

   iii. Complete nomenclature and commercial number of replaceable parts.

   iv. For panel board circuit directories, provide electrical service characteristics, controls and communications. Include as-installed color-coded wiring diagrams.

   v. Describe operating procedures, including start-up, break-in, and routine operating requirements and sequences. Include regulation, control, stopping, shut-down and emergency instructions.

C. Materials and Finishes:

1. Include product data, with catalog number, size, composition and color and texture designations, as well as information for re-ordering custom manufactured products.

2. Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

Article 9.10 Measurement

Measurement for Pump Station 2 Rehabilitation shall be by lump sum and shall consist of all labor, materials, and equipment required to complete the work as shown on the Drawings and described herein.

Article 9.11 Basis of Payment

Payment for this Work shall be in accordance with Division 10 Standard General Provisions, Section 10.07, Measurement and Payment, and shall include full payment for all Work described in this Section.

Unless specifically identified for payment under a separate bid item, the unit price bid for Pump Station 2 Rehabilitation shall include all labor, equipment, and materials necessary

to provide a complete and functional facility as shown on the Drawings and described herein.

Sewer flow control shall be paid for under Section 50.05 Sanitary Sewer Flow Control.

Payment shall be made under the following unit:

ITEM	UNIT
Pump Station 2 Rehabilitation	Lump Sum

DIVISION 70 MISCELLANEOUS

SECTION 70.01 GENERAL

Add the following new Article:

Article 1.3 Utility Facilities

Prior to commencing any Work covered under this division or impacting utility facilities, the Contractor shall contact the Utility and obtain any permits, approvals, or other conditions as required by the Utility to complete any Work on or in the vicinity of their facilities.

SECTION 70.12 TRAFFIC MAINTENANCE

Article 12.6 Public Notice

Add the following paragraphs to the end of the Article:

Advertisements shall have the project name, a map, detailed traffic information, and effective dates of the closure and other information as directed by the Engineer. Advertisements shall be promptly canceled when they have served their purpose. The Contractor shall submit proof of advertisements to the Engineer for review and approval at least 48 hours prior to intended release. The Contractor shall provide a copy of the proof of publication with tear sheet immediately after publication.

DIVISION 75 LANDSCAPING IMPROVEMENTS

SECTION 75.04 SEEDING

Article 4.1 General

Add the following paragraph to the end of the Article.
The Contractor shall submit to the Engineer an analysis of all seed mixes 10 days prior to application. All seeded areas shall be mulched.

Article 4.2 Materials

E. Mulch:

Delete this subarticle and replace with the following:
Mulch material shall consist of one of the following: peat moss or cellulose wood.

Cellulose Wood fiber shall consist of a specially prepared wood fiber processed to contain no growth or germination inhibiting factors. The fiber mulch shall be manufactured and processed in such a manner that the fibers will remain in uniform suspension in water under agitation and will blend with grass seed, fertilizer, and other additives to form a homogeneous slurry. The processed mulch material shall have characteristics to form a blotter-like ground cover on application, having moisture absorption and percolation properties and the ability to cover and hold grass seed in contact with soil. Mulch shall be applied at a rate of 1,500 pounds per acre.

The cellulose wood fiber shall be shipped in packages of uniform weight (plus or minus 5 percent) and bearing the name of the manufacturer and the air-dry weight content. The wood or cellulose fiber shall be dyed a suitable color to facilitate inspection of the placement of the material.

The Contractor shall use a commercial tackifier that is safe and non-toxic, is compatible with the hydraulic slurry components, and complies with Federal, State, and Local water quality laws and regulations.

END OF SPECIAL PROVISIONS

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

SECTION III

TECHNICAL SPECIFICATIONS

Municipality of Anchorage

Anchorage Water and Wastewater Utility

2024 SEWER IMPROVEMENTS
PUMP STATION 2 REHABILITATION

INDEX TO TECHNICAL SPECIFICATIONS

Municipality of Anchorage

Anchorage Water and Wastewater Utility

2024 SEWER IMPROVEMENTS

PUMP STATION 2 REHABILITATION

Municipality of Anchorage

Anchorage Water and Wastewater Utility

2024 SEWER IMPROVEMENTS

PUMP STATION 2 REHABILITATION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Definitions and Administrative and Procedural requirements for quality assurance and quality control.
   2. Requirements for Special Inspection, Observation, and Testing required in accordance with the International Building Code.
   3. Special Inspections identified in this Section and on Drawings will be provided by Owner.
   4. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1.2 DEFINITIONS

A. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved. Testing Agency or Testing laboratory shall mean the same as Approved Agency.

B. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, including requirements for certified/qualified installers to perform Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

C. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with the contract requirements. Services do not include contract enforcement activities performed by Engineer or Owner's Representative.

D. Product Testing: Tests and inspections that are performed by an OSHA Approved NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

E. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work

F. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized

individuals, or that requirements specified apply exclusively to specific trade or trades.

G. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

H. Certified Installer: When used with an entity or individual, "certified installer" means having successfully completed additional training from a product or system manufacturer and has experience installing the system or product. The manufacturer ‘certifies’ the installer’s qualifications, which qualifies the work for the best warranties to the Owner. The certified Installer, whether the entity or the individual should perform and/or supervise the Work as it is being performed.

I. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design professions as defined by the statutory requirements of the professional registration laws of the state or jurisdiction where the Project is to be constructed.

J. Special Inspector: Qualified person employed by Owner who will demonstrate competence to the satisfaction of the building official for inspection of a particular type of construction or operation requiring Special Inspection.

1.3 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.4 QUALITY CONTROL

A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.

B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

C. Perform Work using persons qualified to produce required and specified quality.

D. Products, materials, and equipment may be subject to inspection by Engineer at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.

E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.5 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.6 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current as of date of Contract Documents except where specific date is established by code.

C. Obtain copies of standards and maintain on Site when required by product Specification Sections.

D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

1.7 MANUFACTURER'S FIELD SERVICES

A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment, and commissioning, as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer is subject to approval of Engineer.

C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Provide access to shop or Site for Special Inspection and Testing and Professional Observation.

B. Notify Engineer in advance of required Special Inspection and Professional Observation no later than 48 hours prior to date of Special Inspection and Professional Observation.

C. When required by Registered Design Professional, provide access for mechanical and electrical component inspections for those items requiring certification.

D. Materials and systems, inclusive, shall be inspected during placement where Continuous Special Inspection is required.

E. Materials and systems shall be inspected during or at completion of their placement where Periodic Special Inspection is allowed.
   1. Periodic Special Inspection shall be performed so that Work inspected after, but not during, its placement can be corrected prior to other related Work proceeding and covering inspected Work.
   2. Period Special Inspection does not allow sampling of a portion of the Work. All Work shall be inspected.

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:

1. Temporary electricity.
2. Temporary lighting for construction purposes.
3. Temporary heating.
4. Temporary cooling.
5. Temporary ventilation.
6. Communication services.
7. Temporary sanitary facilities.

B. Construction Facilities:

1. Field offices and sheds.
2. Vehicular access.
3. Parking.
4. Progress cleaning and waste removal.
5. Project identification.
6. Traffic regulation.
7. Fire-prevention facilities.

C. Temporary Controls:

1. Barriers.
2. Enclosures and fencing.
3. Security.
4. Water control.
5. Dust control.
6. Erosion and sediment control.
7. Noise control.
8. Pest and rodent control.
9. Pollution control.

D. Removal of utilities, facilities, and controls.

1.2 REFERENCES

A. ASTM International:

1. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

3. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.3 TEMPORARY FACILITIES

A. Temporary Provisions:

1. Temporary barriers, barricades, covered walkways, fencing, exterior closures, and interior closures.
2. Temporary field offices.
3. Cleaning during construction.
4. Access roads and approaches.
5. Temporary elevator.
6. Temporary sanitary facilities.
7. Temporary heating and ventilating.
8. Temporary electrical service and distribution system for power and lighting.

B. The Contractor shall provide the following items as necessary for execution of the Work including associated costs:

1. Construction aids.
2. Temporary fire protection, dust control, erosion and sediment control, water control, noise control, and other necessary temporary controls.
3. Temporary barriers, barricades, and similar devices as necessary for safety and protection of construction personnel and public.
4. Temporary field office including electrical service.
5. Temporary tree and plant protection.
6. Temporary heating.
7. Electrical service required in addition to temporary service and distribution.
8. Temporary provisions for protection of installed Work.

1.4 TEMPORARY ELECTRICITY

A. Provide and pay for power service required from utility source as needed for construction operation. Use Owner's existing power service, provide separate metering, and reimburse Owner for cost of energy used.

B. Provide temporary electric feeder from existing building electrical service at location as directed by Owner. Do not disrupt Owner's use of service.

C. Complement existing power service capacity and characteristics as required for construction operations.

D. Provide suitable, flexible power cords as required for portable construction tools and equipment.

E. Provide main service disconnect and overcurrent protection at convenient location.

F. Permanent convenience receptacles shall not be used during construction.

G. Provide distribution equipment, wiring, and outlets for single-phase branch circuits for power and lighting.
   1. Provide 20-ampere, single-phase branch circuits for lighting.

1.5 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain incandescent lighting for construction operations to achieve minimum lighting level of 2 watts/sq ft.

B. Provide and maintain 1 watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.

C. Provide and maintain 0.25 watt/sq ft HID or equivalent LED lighting to interior work areas after dark for security purposes.

D. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, lamps, and the like, for specified lighting levels.

E. Maintain lighting and provide routine repairs.

F. Permanent building lighting may be used during construction.

1.6 TEMPORARY HEATING

A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations. Provide separate metering and reimburse Owner for cost of energy used.

B. Before operating permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Replace filters at Substantial Completion.

C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress unless indicated otherwise in individual product Sections.

1.7 TEMPORARY COOLING

A. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations. Provide separate metering and reimburse Owner for cost of energy used.

B. Before operating permanent equipment for temporary cooling purposes, verify installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Replace filters at Substantial Completion.

C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress unless indicated otherwise in individual product Sections.

1.8 TEMPORARY VENTILATION

A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.9 COMMUNICATION SERVICES

A. Telephone Service: Provide, maintain, and pay for telephone service to field office at time of Project mobilization and until completion of Work.

B. Internet Service: Provide, maintain, and pay for broadband Internet service to field office at time of Project mobilization. Provide desktop computer with Microsoft operating system and appropriate office function software, modem, and printer.

1.10 TEMPORARY WATER SERVICE

A. Provide and pay for suitable quality water service as needed to maintain specified conditions for construction operations.

1.11 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of Project mobilization.

1.12 FIELD OFFICES AND SHEDS

A. Do not use existing facilities for field offices or for storage.

B. Provide space for Project meetings, with table and chairs to accommodate six persons.

C. Resident Project Representative will utilize existing facility space for field office.

D. Locate field office and sheds a minimum distance of 30 feet from existing structures.

E. Construction: Portable or mobile buildings, or buildings constructed with floors raised aboveground, securely fixed to foundations with steps and landings at entrance doors.

1. Construction: Structurally sound, secure, weathertight enclosures for office and storage spaces. Maintain during progress of Work; remove enclosures at completion of Work.
2. Thermal Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.
3. Exterior Materials: Weather-resistant, finished in colors acceptable to Engineer.
4. Interior Materials in Field Offices: Sheet-type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
5. Lighting for Field Offices: 50 ft-C at desktop height; exterior lighting at entrance doors.

6. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.

F. Environmental Control:

1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions.
2. Storage Spaces: Heating and ventilating as needed to maintain products according to Contract Documents; lighting for maintenance and inspection of products.

G. Storage Areas and Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and inspection of products.

H. Preparation: Fill and grade Sites for temporary structures sloped for drainage away from buildings.

I. Installation:

1. Install field office ready for occupancy 15 days after date established by Notice to Proceed.
2. Employee Residential Occupancy: Not allowed on Owner's property.

J. Maintenance and Cleaning:

1. Weekly janitorial services for field office; periodic cleaning and maintenance for sheds and storage areas.
2. Maintain walks free of mud, water, snow, and the like.

K. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas to same or better condition as original condition.

1.13 VEHICULAR ACCESS

A. Locate as approved by Owner.

B. Provide unimpeded access for emergency vehicles. Maintain 20 foot-wide driveways with turning space between and around combustible materials.

C. Provide and maintain access to fire hydrants and control valves free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Use existing on-Site roads for construction traffic.

1.14 PARKING

A. Provide temporary gravel surface parking areas to accommodate construction personnel.

B. Locate as approved by Owner.

C. If Site space is not adequate, provide additional off-Site parking.

D. Use of existing on-Site streets and driveways used for construction traffic is permitted. Tracked vehicles are not allowed on paved areas.

E. Use of existing parking facilities used by construction personnel is not permitted.

F. Do not allow heavy vehicles or construction equipment in parking areas.

G. Do not allow vehicle parking on existing pavement.

H. Designate two parking spaces for Engineer and Owner.

I. Permanent Pavements and Parking Facilities:

1. Bases for permanent roads and parking areas may be used for construction traffic.
2. Avoid traffic loading beyond paving design capacity. Tracked vehicles are not allowed.
3. Use of permanent parking structures is not permitted.

J. Maintenance:

1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, ice, and the like.
2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.

K. Removal, Repair:

1. Remove temporary materials and construction at Substantial Completion.
2. Remove underground Work and compacted materials to depth of 2 feet; fill and grade Site as indicated.
3. Repair existing facilities damaged by use, to original condition.

L. Mud from Site vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.15 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain Site in clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, before enclosing spaces.

C. Broom and vacuum clean interior areas before starting surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and rubbish from Site weekly and dispose of off-Site.

E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.16 TRAFFIC REGULATION

A. Signs, Signals, and Devices:

1. Post-Mounted and Wall-Mounted Traffic Control and Informational Signs: As approved by authorities having jurisdiction.
2. Traffic Control Signals: As approved by local jurisdictions.
3. Traffic Cones, Drums, Flares, and Lights: As approved by authorities having jurisdiction.
4. Flag Person Equipment: As required by authorities having jurisdiction.

B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

C. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

D. Haul Routes:

1. Consult with authorities having jurisdiction and establish public thoroughfares to be used for haul routes and Site access.
2. Confine construction traffic to designated haul routes.
3. Provide traffic control at critical areas of haul routes to regulate traffic and to minimize interference with public traffic.

E. Traffic Signs and Signals:

1. Provide signs at approaches to Site and on Site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
2. Provide, operate, and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations.
3. Relocate signs and signals as Work progresses, to maintain effective traffic control.

F. Removal:

1. Remove equipment and devices at Substantial Completion.
2. Repair damage caused by installation.
3. Remove post settings to depth of 2 feet.

1.17 FIRE-PREVENTION FACILITIES

A. Prohibit smoking within facility under construction and demolition. Designate area on Site where smoking is permitted. Provide approved ashtrays in designated smoking areas.

B. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.

C. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.

1. Provide one fire extinguisher at each stairway on each floor of facility under construction and demolition.
2. Provide minimum of one fire extinguisher in every construction trailer and storage shed.
3. Provide minimum of one fire extinguisher on roof during roofing operations using heat-producing equipment.

1.18 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way.

C. Tree and Plant Protection: Preserve and protect existing trees and plants designated to remain.

1. Protect areas within drip lines from traffic, parking, storage, dumping, chemically injurious materials and liquids, ponding, and continuous running water.
2. Replace trees and plants damaged by construction operations.

D. Protect non-owned vehicular traffic, stored materials, Site, and structures from damage.

1.19 ENCLOSURES AND FENCING

A. Construction: Commercial-grade chain-link fence.

B. Provide 6-foot-high fence around construction Site; equip with vehicular and pedestrian gates with locks.

C. Exterior Enclosures:

1. Provide temporary insulated weathertight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures

identified in individual Specification Sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.20 SECURITY

A. Security Program:

1. Protect Work on existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
2. Initiate program in coordination with Owner's existing security system at Project mobilization.
3. Maintain program throughout construction period until Owner's acceptance precludes need for Contractor's security.

B. Entry Control:

1. Restrict entrance of persons and vehicles to Project Site and existing facilities.
2. Allow entrance only to authorized persons with proper identification.
3. Maintain log of workers and visitors and make available to Owner on request.
4. Control entrance of persons and vehicles related to Owner's operations.

1.21 WATER CONTROL

A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment.

B. Protect Site from puddles or running water. Provide water barriers as required to protect Site from soil erosion.

1.22 DUST CONTROL

A. Execute Work by methods that minimize raising dust from construction operations.

B. Provide positive means to prevent airborne dust from dispersing into atmosphere.

1.23 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills from borrow and waste disposal areas. Prevent erosion and sedimentation.

B. Minimize surface area of bare soil exposed at one time.

C. Provide temporary measures including berms, dikes, drains, and other devices to prevent water flow.

D. Construct fill and waste areas by selective placement to avoid erosive surface silts and clays.

E. Periodically inspect earthwork to detect evidence of erosion and sedimentation. Promptly apply corrective measures.

1.24 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise and noise produced by construction operations.

1.25 PEST AND RODENT CONTROL

A. Provide methods, means, and facilities to prevent pests and insects from damaging the Work and entering facility.

B. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.26 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.

B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.27 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials before Substantial Completion inspection.

B. Remove underground installations to minimum depth of 2 feet. Grade Site as indicated on Drawings.

C. Clean and repair damage caused by installation or use of temporary Work.

D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Physical completion procedures.
   3. Final completion procedures.
   4. Warranties.
   5. Final cleaning.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request
   1. Submit required number of copies of the approved O&M manuals.
   2. Complete Final Cleaning.
   3. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   4. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   5. Advise Owner of pending insurance changeover requirements.
   6. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   7. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   8. Complete startup and testing of systems.
   9. Submit test/adjust/balance (TAB) report.
   10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   11. Advise Owner of changeover in electric and other utilities.
   12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   13. Complete final cleaning requirements, including touchup painting.
   14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
   15. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner’s personnel of changeover in security provisions.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will either schedule the inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion

after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by the Engineer, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Physical Completion (punch list).

1.3 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
   1. Organize list of spaces in sequential order.
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Date.
      b. Name of Contractor.
      c. Page number.
   4. Submit list of incomplete items in the following format:
      a. PDF electronic file on project web site.

1.4 PHYSICAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining Physical completion, the Contractor shall complete the following:
   1. Completion of Systems Commissioning.
   2. Submit certified copy of the completed punch list issued with the Substantial Completion Certificate, with the Contractor signature certifying the completion, correction, or otherwise resolution of each item on the list. Once this certified punch list is received, an inspection will be scheduled with the Engineer to verify and confirm completion/correction of all items on the list including corrected items from building systems commissioning.
      a. For Physical Completion the entire punch list including completion of Systems Commissioning item shall be complete.

B. Inspection: Submit a written request for Physical Completion inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Physical Completion after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 REINSPECTION FEES

A. Should status of completion of Work require re-inspection by Engineer due to failure of Work to comply with Contractor's claims on initial inspection, OWNER will deduct the amount of costs for re-inspection services from final payment to the Contractor.

1.6 FINAL COMPLETION

A. Preliminary Procedures: Before requesting Final Completion, complete the following:
   1. Submit certified copy of Physical Completion Certificate.
   2. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   3. Submit required Record Documents – as-built redlines.
   4. Training Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
   5. Submit Contract closeout documents for release and payment of Retainage.

1.7 WARRANTIES

A. Submittal Time: Submit written project product warranties with project O&M manuals prior to the Substantial Completion Inspection.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
   4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.

C. Provide additional copies of each warranty in operation and maintenance manuals.

1.8 ADJUSTING

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

1.9 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 Physical Completion Request.

1.10 PROJECT RECORD DOCUMENTS

A. Maintain on Site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, product data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates used.
3. Changes made by Addenda, bulletin, Change Order, and modifications.

F. Record Drawings: Legibly mark each item to record actual construction as follows:

1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
2. Include locations of concealed elements of the Work.
3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
5. Identify and locate existing buried or concealed items encountered during Project.
6. Measured depths of foundations in relation to finish main floor datum.
7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
9. Field changes of dimension and detail.
10. Details not on original Drawings.

G. Submit PDF electronic files of marked-up documents to Engineer with claim for final Application for Payment.

1.11 OPERATION AND MAINTENANCE DATA

A. Submit in PDF composite electronic indexed file.

B. Submit data bound in 8-1/2 x 11-inchtext pages, three D side ring binders with durable plastic covers.

C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project, and subject matter of binder when multiple binders are required.

D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

F. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include 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.
    f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
    g. Safety precautions to be taken when operating and maintaining or working near equipment.

3. Part 3: Project documents and certificates, including the following:

    a. Shop Drawings and product data.
    b. Air and water balance reports.
    c. Certificates.
    d. Photocopies of warranties.

PART 2 - PRODUCTS

2.1 MATERIALS – FINAL CLEANING

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
      a. Remove tools, construction equipment, machinery, and surplus material from Project site.
      b. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
      c. Vacuum carpet and similar soft surfaces, removing debris and excess nap; professionally shampoo carpet.
      d. Remove labels that are not permanent.
      e. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
         1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
      f. Wipe surfaces of electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
      g. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
      h. Professionally clean bathrooms including all plumbing fixtures, floors, stalls, walls, and other surfaces, used by contractor and construction crews during the project.
      i. Leave Project clean and ready for occupancy.

END OF SECTION

SECTION 01 75 00 - STARTING AND ADJUSTING

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. The Contractor shall perform facility Starting and Adjusting as described herein.

B. Equipment and systems startup and testing shall be done in accordance with the requirements of the applicable specification Divisions.

1.2 RELATED SECTIONS

A. Municipality of Anchorage Standard Specifications (MASS), Special Provisions, and Division 1 - General Requirements apply to Work of this Section.

B. Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC)

C. Division 25 – Integrated Automation

D. Division 26 – Electrical

E. Division 27 – Communications

F. Division 28 – Electronic Safety and Security

G. Division 35 – Waterway and Marine Construction

H. Division 40 – Process Integration

I. Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment

1.3 DEFINITIONS

A. Facility Startup: Facility Startup is the process of putting the Project in operating order. Items of Work to be completed prior to Facility Startup include demolition of the existing systems as applicable, procurement and installation of the new system, cleaning, flushing, pressure testing and disinfection. Facility Startup is to include the following items:

1. Verification by equipment manufacturer(s) that their equipment is properly installed and ready for startup.
2. Confirmation that all electrical power and control communications connections are correctly terminated.
3. Configuration of all instrumentation and control devices, and rotating equipment operation upon being energized.
4. Confirmation of process flow rates over the entire range of specified system operating conditions.

5. Supporting the Owner in confirmation of control system operation and equipment performance for all specified control sequences.
6. Operation of the system over the period specified for Facility Startup to verify system operation and performance.
7. Performance Testing to verify performance goals specified for the Project.

B. Functional Test: A test or tests in the presence of the Owner to demonstrate that the installed equipment or system meets operational performance requirements including, but not limited to flow rates, noise, vibration, alignment, speed, proper electrical and mechanical connections, testing and balancing of the HVAC system, thrust restraint, proper rotation, and initial servicing.

C. Operation Period: The operation period begins when the facility has been successfully started up as defined under Paragraph Startup Test Period and has met all Substantial Completion requirements.

D. Performance Test: A test performed in the presence of the Owner and after any required Functional Test specified, to demonstrate and confirm that the equipment and/or system meets the specified performance requirements.

E. Significant Interruption: May include any of the following events:
1. Failure of Contractor to maintain qualified onsite startup personnel as scheduled.
2. Failure to meet specified performance for more than 2 consecutive hours.
3. Failure of any critical equipment unit, systems, or subsystem that is not satisfactorily corrected within 5 hours after failure.
4. Failure of noncritical unit, systems, or subsystem that is not satisfactorily corrected within 8 hours after failure.
5. As may be determined by Owner.

F. Startup Test Period:
1. Startup of the entire facility or any portion thereof includes coordinated operation of the facilities by the Contractor, Subcontractors, Owner, operating personnel, and manufacturer's representatives for equipment items and systems after all required Functional Tests have been completed and those Performance Tests deemed necessary for the safe operation of the entire facility have been completed.
2. Startup of the entire facility or any portion thereof shall be considered complete when, in the opinion of the Owner, the facility or designated portion has operated in the manner intended for 3 continuous days without Significant Interruption. This period is in addition to any training, Functional Testing, or Performance Test periods specified elsewhere. A Significant Interruption will require the startup then in progress to be stopped and restarted after corrections are made.

G. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment. Examples of Systems on this Project are:
1. Electrically and manually actuated gates and valves
2. Instrumentation: flow, level, pressure
3. Wastewater Pumps
4. Piping and associated valves, operators, and instrumentation
5. Gates and appurtenances and associated operators

6. Power supply and electrical, including standby generator and uninterruptible power supplies
7. Network communications and cabling
8. Controls/SCADA
9. HVAC
10. Plumbing

1.4 SYSTEM INTEGRATION SERVICES

A. The Owner's System Integration Service Provider, Snowdweller Industrial, LLC, will provide programming and SCADA system integration services, including configuration of equipment and devices furnished and installed by the Contractor. The Owner's System Integrator will perform the following tasks during construction:
   1. Final configuration of new instrument devices after installation, testing and functional verification is complete. Contractor is responsible for calibration of instrumentation, initial configuration of instrumentation per specifications and functional verification of equipment electrical and mechanical connections. Contractor is to provide formal documentation of all testing performed.
   2. Temporary programming and configuration as necessary to support facility operations during construction, cut-over and testing of new systems and equipment.
   3. Communications configuration and SCADA system integration of new systems.

1.5 SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6.

B. Administrative Submittals:
   1. Functional and performance test plan for temporary equipment, and replacement equipment and systems. Submit at least 14 calendar days prior to start of related testing.
   2. Schedule for Facility Startup to address:
      a. Completion date for pre-startup activities including schedule and preparation activities, temporary equipment installation, new equipment installation completion, and pressure testing, as applicable.
      b. Verification of installation by Manufacturer/Equipment Suppliers.
      c. Startup and Functional Testing.

C. Quality Control Submittals
   1. Contractor's pressure testing results for new process pumping/piping systems
   2. Manufacturer's Certificate of Proper Installation and Operation and Manufacturer's Certificate of Training.

1.6 CONTRACTOR FACILITY STARTUP RESPONSIBILITIES

A. Complete installation of all systems and equipment identified in the Contract Documents.

B. Confirm continuity in communications cabling routed between control panels and devices.

C. Confirm voltage and proper rotation of electrically powered devices.

D. Prepare and submit testing plans and schedules.

E. Coordinate the Equipment Manufacturers' efforts to visit the site, review the installation of equipment they have supplied for the Project, and assist with functional testing.

F. Conduct pressure testing of all wetted systems affected by Project.

G. Correct any deficiencies identified before system start up including:
   1. Power supply and/or communications connections
   2. Direction of movement for all rotating equipment
   3. Leaks and/or other breaches in installed system integrity

1.7 SUPPORT FOR SYSTEM INTEGRATION SERVICES

A. Upon achieving Substantial Completion, the Owner's System Integration Service Provider, Snowdweller Industrial, LLC will:
   1. Provide configuration and programming required for manual, automatic, and remote control of the new systems.

B. During the functional verification of the new systems, for each major system the Contractor is to provide the following resources to the project site:
   1. On-site support from the system manufacturer's representative for a period of one 8-hour (measured as time on the project site) weekday/non-holiday calendar day, coinciding with the startup and functional testing period.
   2. On-site support from a journeyman pipefitter for a period of one 8-hour (measured as time on the project site) weekday/non-holiday calendar day, coinciding with the startup and functional testing period.
   3. On-site support from a journeyman electrician for a period of one 8-hour (measured as time on the project site) weekday/non-holiday calendar day, coinciding with the startup and functional testing period.
   4. On-site support from the Contractor's project superintendent for the startup and functional testing period.
   5. Tools, equipment, and miscellaneous materials for the pipefitter and electrician appropriate for undertaking troubleshooting efforts for the systems, equipment, and controls.

C. Assist with verification of proper installation, adjustment, function, performance, and operation of equipment, systems, control devices and systems, and required interfaces individually and in conjunction with process instrumentation and control system.

D. Verification of functional performance is to be the responsibility of the Engineer with assistance from the Contractor, and shall accomplish the following:
   1. Demonstrate the operation and control of the following:
      a. Electrically and manually actuated gates and valves
      b. Instrumentation: flow, level, pressure

c. Wastewater Pumps
d. Piping and associated valves, operators, and instrumentation
e. Gates and appurtenances and associated operators
f. Power supply electrical switchgear and standby generator
g. Controls/SCADA.
h. Network communications
i. HVAC
j. Plumbing

2. As applicable, confirm operation and control features:
   a. Variable speed operation
   b. Pump delivery rate(s)
   c. Fan delivery rate(s)
   d. Pump and/or motor vibrations and noise
   e. Pump and/or motor alternation feature
3. Provide operations training for the Owner's staff as part of Manufacturer's Services.

1.8 OWNER FACILITY STARTUP RESPONSIBILITIES

A. General:
   1. Review Contractor's test plan and schedule.
   2. Witness each functional or performance test.

B. Startup Test Period:
   1. Operate process equipment with support of Contractor.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. General:
   1. Complete installation of equipment and components identified in the Contract Documents including electrical power, instrumentation and automation communications, process piping, and instrument systems.
   2. Complete and secure certificates of approval for installed components from Manufacturer's Representatives for Contractor furnished installed equipment and components.
   3. Furnish qualified Manufacturer's Representatives at the site to provide Manufacturers' Services for the following:
      a. Electrically actuated gates and valves
      b. Instrumentation: flow, level, pressure
      c. Variable Frequency Drives
      d. Wastewater Pumps
      e. Electrical switchgear
   4. Designate and furnish one or more persons to be responsible for coordinating and expediting Contractor's Facility Startup duties. The person or persons shall

be present during facility startup meetings and shall be available at all times during the Facility Startup period.

5. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing.

B. Cleaning and checking prior to starting Functional Testing:
   1. Calibrate testing equipment.
   2. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.
   3. Lubricate equipment in accordance with manufacturer's instructions.
   4. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
   5. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
   6. Check power supply to electric-powered equipment for correct voltage.
   7. Adjust clearances and torques.
   8. Test for leaks.
   9. Obtain completion of applicable portions of Manufacturer's Certificate of Proper Installation.

C. Ready-to-test determination will be by Owner based at least on the following:
   1. Notification by Contractor of equipment and system readiness for testing.
   2. Acceptable testing plan.
   3. Acceptable Operation and Maintenance Manuals.
   4. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.
   5. Availability of Equipment Supplier’s Representative to assist in inspection and testing of installed equipment.
   6. Equipment and electrical tagging complete.
   7. All spare parts and special tools delivered to Owner.

3.2 FUNCTIONAL TESTING-GENERAL

A. Begin testing at a time mutually agreed upon by the Owner, Equipment Supplier, and Contractor.

B. Notify in writing Owner and Representative(s) at least 10 days prior to scheduled date of Functional Tests.

C. Separate items of equipment demonstrated to function properly during subsystem testing may require no further Functional Test if documentation of subsystem testing is acceptable to Owner.

D. Conduct Functional Tests as specified for each equipment item or system.

E. Provide the following:
   1. As a condition of Substantial Completion, demonstrate all operational features and instrumentation and control functions while in manual operational mode.

2. Prior to Final Completion, assist the Owner’s System Integration Service Provider in functional verification of the new systems, process operational features, and instrumentation and control functions while in an automated operational mode.

F. Performance Testing shall not commence until the equipment or system meets the specified Functional Tests.

3.3 PERFORMANCE TEST-GENERAL

A. Begin testing at a time mutually agreed upon by the Owner and Contractor.

B. Owner will be present during test. Notify in writing Owner and Manufacturer’s Representative(s) at least 14 days prior to scheduled date of Functional Tests.

C. Conduct performance tests specified for each equipment item or system.

D. Unless otherwise indicated, furnish all labor, materials, and supplies for conducting the test and taking all samples and performance measurements.

E. Prepare Performance Test report summarizing test method. Include test logs, pertinent calculations, and certification of performance.

3.4 STARTUP ACTIVITIES

A. Designate and furnish one or more persons to be responsible for coordinating and expediting Contractor's Facility Startup duties.

B. When Facility Startup has commenced, schedule remaining Work so as not to interfere with or delay the completion of Facility Startup. Support the Facility Startup activities with adequate staff to prevent delays and process upsets. This staff shall include, but not be limited to, major equipment and system Manufacturers' Representatives, electricians, instrumentation technicians, and plumbers.

C. Supply and coordinate specified manufacturer's Facility Startup services.

D. Make adjustments, repairs, and corrections necessary to complete facility startup.

E. After the facility is operating, complete the testing of those items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to startup test period.

3.5 CONTINUOUS OPERATIONS

A. Owner will accept equipment and systems as ready for continuous operation only after successful startup is complete, and reports submitted, and manufacturers' services completed for training of Owner’s personnel.

END OF SECTION

SECTION 01 88 15 - SEISMIC ANCHORAGE AND BRACING

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTIONS

A. General Requirements
   1. Apply the requirements for wind and seismic protection measures, described in this section, to the new/modified mechanical, electrical, distribution and process equipment and systems, in accordance with the International Building Code and ASCE 7. Provide seismic protection measures in addition to any other requirements called for in other sections of these specifications. The design for seismic protection shall be based on a Risk Category III and on site specific seismic coefficients specified on the structural drawings. Accomplish resistance to lateral forces induced by earthquake forces without consideration of friction resulting from gravity loads.

B. Mechanical, Electrical, Distribution and Process Equipment
   1. All equipment shall be seismically anchored and braced, except items that are positively attached to the structure; have flexible connections provided between the component and associated ductwork, piping, and conduit; and either:
      a. The components weighs 400 pounds or less, and has a center of mass located 4 feet or less above the adjacent floor; or
      b. The component weighs 20 pounds or less or, in the case of distributed systems, 5 pounds per linear feet (PLF) or less.

C. Mechanical, Electrical, Distribution and Process Systems
   1. The following systems shall be seismically protected:
      a. All piping inside the building except as specifically stated below in section 1.1-D "Items Not Covered By This Section".
      b. All Water Supply Systems.
      c. Sanitary Sewer Systems.
      d. All Process Piping.
      e. Heat/Venting Distribution Systems.

D. Items Not Covered By This Section
   1. Fire Protection Systems
   2. Items requiring no seismic restraint including:
      a. Piping in mechanical equipment rooms less than 1-1/4 inches inside diameter.
      b. All other piping less than 2-1/2 inches inside diameter.
      c. Rectangular air handling ducts less than 6 square feet in cross sectional area.
      d. Round air handling ducts less than 28 inches in diameter.
      e. Piping suspended by individual hangers 12 inches or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.
      f. Ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the supporting structural member. All hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the

entire run shall be braced. Interior piping and ducts not listed above shall be seismically protected in accordance with the provisions of this specification.

E. Contractor Designed Anchoring and Bracing
   1. Submit copies of the seismic anchoring and bracing design calculations and shop drawings for all Mechanical, Electrical, Distribution and Process equipment and systems. Calculations and shop drawings shall be approved, certified, stamped and signed by a Professional Engineer registered in the State of Alaska. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the anchoring and bracing. Design of the anchoring and bracing shall be in accordance with ASCE 7. Resistance to lateral forces induced by earthquake forces shall be accomplished without consideration of friction resulting from gravity loads. The anchoring and bracing for mechanical and electrical equipment and systems shall be developed by the Contractor.

1.2 SUBMITTALS

A. Engineer of Record approval is required for submittals. Submit the following:
   1. Calculations
      a. Contractor Designed Anchoring and Bracing
   2. Shop Drawings:
      a. Contractor Designed Anchoring and Bracing
      b. Couplings
      c. Resilient Vibration Isolation Devices
      d. Equipment Requirements
   3. Product Data:
      a. Anchors
      b. Bracing
      c. Equipment Requirements
   4. Test Reports
      a. Anchors

PART 2 - PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

Submit detail drawings along with calculations, catalog cuts, templates, and erection and installation details. Indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction.

A. Rigidly Mounted Equipment
   1. Each item of rigid equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, duct, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

2.2 FLEXIBLE COUPLINGS

A. Flexible couplings shall have same pressure and temperature ratings as adjoining pipe.

2.3 FLEXIBLE MECHANICAL JOINTS

A. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.

B. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets.

2.4 SWAY BRACING

A. Material used for members listed in this section, shall be structural steel conforming with the following:
   1. Plates, rods, and rolled shapes, ASTM A36/A36M
   2. Wire rope, ASTM A603
   3. Tubes, ASTM A500/A500M, Grade B
   4. Pipes, ASTM A53/A53M, Type E, Grade B
   5. Light gauge angles, less than 1/8 inch thickness, ASTM A653/A653M

PART 3 - EXECUTION

3.1 COUPLING AND BRACING

A. Submit detail drawings, as specified here and throughout this specification, along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

B. Piping grouped for support on trapeze-type hangers shall be braced at the most frequent interval as determined by applying the requirements of this specification to each piping run on the common support.

C. Bracing components shall be sized as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 BUILDING DRIFT

A. Joints capable of accommodating seismic displacements shall be provided for vertical piping between floors of the building, where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. Horizontal piping across expansion joints shall accommodate the resultant of the drifts of each building unit in each orthogonal direction. For threaded piping, swing joints made of the same piping material shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 feet per foot of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

B. Sway braces for a piping, conduit and duct runs shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided.

3.3 FLEXIBLE COUPLINGS OR JOINTS

A. Building Piping
   1. Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers for pipe larger than 3-1/2 inches in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to satisfy these requirements.

3.4 PIPE SLEEVES

A. Pipe sleeves in interior non-fire rated walls shall be sized to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve.

3.5 SPREADERS

A. Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields.

3.6 SWAY BRACING FOR EQUIPMENT

A. Suspended Equipment and Light Fixtures
   1. Provide equipment sway bracing for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than ½-

inch bolts. Provide sufficient braces for equipment to resist a horizontal force as specified in ASCE 7 without exceeding safe working stress of bracing components. Provide, for approval, specific force calculations in accordance with ASCE 7 for the equipment in the project. Submit details of equipment bracing for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

B. Roof, Floor and Pad Mounted Equipment
   1. Shear Resistance
      a. Bolt to the structure all mounted equipment. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with the engineered requirements.
   2. Overturning Resistance
      a. Use the ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads to determine if overturning forces need to be considered in the sizing of anchors. Provide calculations to verify the adequacy of the anchors for combined shear and overturning.

3.7 SWAY BRACES FOR PIPING

A. Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes.

B. Transverse Sway Bracing
   1. Transverse sway bracing for steel and copper pipe, shall be provided as required by design. All runs (length of pipe between end joints) shall have a minimum of two transverse braces.

C. Longitudinal Sway Bracing
   1. Longitudinal sway bracing shall be provided at 40 foot intervals unless otherwise required by design. All runs (length of pipe between end joints) shall have one longitudinal brace minimum. Branch lines, walls, or floors shall not be used as sway braces.

D. Vertical Runs
   1. Run is defined as length of pipe between end joints. Vertical runs of piping shall be braced at not more than 10 foot vertical intervals. Braces for vertical runs shall be above the center of gravity of the segment being braced. Sway braces shall attach to the structural system and shall not be connected to branch lines, walls, or floors.

E. Clamps and Hangers
   1. Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation.

3.8 SWAY BRACES FOR DUCTS

A. Braced Ducts
   1. Bracing details and spacing for rectangular and round ducts shall be in accordance with ANSI/SMACNA 001-2008, including Appendix E.

B. Unbraced Ducts
   1. Hangers for unbraced ducts shall be attached to the duct within 2 inches of the top of the duct in accordance with ANSI/SMACNA 001-2008. Unbraced ducts shall be installed with a 6 inch minimum clearance to vertical ceiling hanger wires.

3.9 RESILIENT VIBRATION ISOLATION DEVICES

A. Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in Paragraph 3.1, except that an equipment weight equal to five times the actual equipment weight shall be used.
   1. Resilient and Spring-Type Vibration Devices
      a. Select vibration isolation devices so that the maximum movement of equipment from the static deflection point is 1/2 inches.
   2. Multidirectional Seismic Snubbers
      a. Install multidirectional seismic snubbers employing elastomeric pads on floor- or slab-mounted equipment. These snubbers shall provide 1/4 inches free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

3.10 SWAY BRACES FOR CONDUIT

A. Conduit shall be braced as for an equivalent weight pipe.

3.11 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

A. Pendant Fixtures
   1. Pendant fixtures shall conform to the requirements of ASCE 7.

B. Ceiling Attached Fixtures
   1. Recessed Lighting Fixtures
      a. Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system built in accordance with the IBC for suspended ceiling systems. Seismic protection for the fixtures shall conform to the requirements of the IBC. Recessed lighting fixtures not over 56 pounds in weight may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic

design. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw attachment.

2. Surface-Mounted Lighting Fixtures
   a. Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system built in accordance with the IBC.
3. Wall-Mounted Emergency Light Unit
   a. Attachments for wall-mounted emergency light units shall be designed and secured for the worst expected seismic disturbance at the site.

3.12 EXPANSION OR CHEMICALLY BONDED ANCHORS

A. Test in place expansion and chemically bonded anchors as specified in the International Code Council (ICC) test reports for the anchors, conducted by an independent testing agency; testing shall be performed on random anchor bolts.

3.13 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

A. Perform special inspections and testing for seismic-resisting systems and components in accordance with the structural drawings.

END OF SECTION

SECTION 03 01 00 - MAINTENANCE OF CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Epoxy adhesive injection materials.

2. Patching of spalled concrete.

1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
3. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
4. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
5. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [**50-mm**] Cube Specimens).
6. ASTM C150/C150M - Standard Specification for Portland Cement.
7. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.
8. ASTM C293/C293M - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
9. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
10. ASTM C882/C882M - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
11. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
12. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
13. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
14. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.3 SUBMITTALS

A. Product Data: Submit product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Manufacturer Instructions: Submit mixing instructions.

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

E. Qualifications Statements:
   1. Submit manufacturer's approval of applicator.

1.4 QUALITY ASSURANCE

A. Perform Work according to ACI 301 standards.

B. Perform work per manufacturer’s specifications.

C. Should a conflict arise between drawings, specifications, etc., the more stringent shall apply.

D. Refer to structural drawings for special inspection and testing requirements.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Applicator: Company specializing in performing Work of this Section with minimum three years documented.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:

   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Provide additional protection according to manufacturer instructions.

1.7 EXISTING CONDITIONS

A. Field Measurements:

   1. Verify field measurements prior to installation.

PART 2 - PRODUCTS

2.1 EPOXY ADHESIVE

A. Description:

1. Type: Two-part.

B. Minimum Characteristics:

1. Bond Strength:

a. 2,700 psi.
b. Comply with ASTM C882/C882M.

2. Tensile Strength:

a. 6,600.
b. Comply with ASTM D638.

2.2 REPAIR MORTARS

A. Product: Sikacrete-211 or approved equivalent.

B. Description:

1. Type: One-component, cementitious, pumpable and pourable concrete mix.

C. Minimum Characteristics:

1. Min Compressive Strength:

a. 5,000 psi at 28 days.
b. Comply with ASTM C 39.

2. Min Flexural Strength:

a. 700 psi at 28 days.
b. Comply with ASTM C 293.

3. Shrinkage:

a. < 0.05% at 28 days.
b. Comply with ASTM C 157.

PART 3 - EXECUTION

3.1 EPOXY RESIN INJECTION:

A. Examination
   1. Verify that surfaces are ready to receive Work.
   2. Refer to structural drawings for special inspection and testing requirements
   3. Cleaning:
      a. Clean concrete surfaces of dirt, laitance, corrosion, and other contamination.
      b. Scrub with wire brush using water.
      c. Rinse surface and allow to dry.
      d. Flush out cracks and voids with water to remove laitance and dirt.
   4. Ports:
      a. Provide temporary entry ports spaced to facilitate movement of fluids between ports.
      b. Size: Not deeper than depth of crack to be filled, or diameter not greater than thickness of crack.
   5. Provide temporary seal at concrete surface to prevent leakage of adhesive.
   6. Remove broken and soft concrete ¼ deep.
   7. Clean surfaces mechanically, wash with water.

B. Application
   1. Epoxy Resin Injection:
      a. Inject epoxy-resin adhesive into prepared ports under pressure, using equipment appropriate for particular application.
      b. Begin injection at lower entry port and continue until adhesive appears in adjacent entry port, continuing from port to port until entire crack is filled.
      c. Remove temporary seal and excess adhesive.
      d. Clean surfaces adjacent to repair and blend finish.

3.2 PATCHING OF SPALLED CONCRETE:

A. Examination
   1. Verify that surfaces are ready to receive Work.
   2. Refer to structural drawings for special inspection and testing requirements.
   3. Cleaning:
      a. Be sure the repair area is not less than 1 inch in depth, saw cut the perimeter edges of the repair area, cut at a dovetail angle if possible.
      b. Clean concrete surfaces of dirt, laitance, corrosion, and other contamination.
      c. Scrub with wire brush using water.
      d. Rinse surface and allow to dry.
      e. Flush out cracks and voids with water to remove laitance and dirt.

B. Application
   1. Mortar Repair:
      a. Prime the prepared substrates per manufacturer’s specifications.

b. Mix product per manufacturer's specifications.
c. Apply product per manufacturer's specifications.
d. Cure and protect product per manufacturer's specifications.

END OF SECTION

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Qualification Data: For testing agency.

E. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Bonding agents.
7. Repair materials.

F. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

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

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency acceptable to authorities having jurisdiction**,** qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage

1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

1. ACI 301
2. ACI 117

2.2 FORM-FACING MATERIALS

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

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

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

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

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

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: Per Structural Drawings.

2.4 REINFORCEMENT ACCESSORIES

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

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Normal-Weight Aggregates: ASTM C 33 coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

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

C. Air-Entraining Admixture: ASTM C 260/C 260M.

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

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

E. Water: ASTM C 94 and potable.

2.6 CURING MATERIALS

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

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

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products
   a. Dayton Superior: Cure & Seal 1315 J22WB.
   b. L&M Construction Chemical, Inc.;Lumiseal WB Plus.
   c. W.R. Meadows, Inc. Vocomp-30.

2.7 RELATED MATERIALS

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

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

2.8 REPAIR MATERIALS

A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Basis of Design; PLANITOPX or ARDEX

2.9 CONCRETE MIXTURES, GENERAL

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

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

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

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

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Grade Beam, Pile Cap & Floors: Normal-weight concrete.

1. Minimum Compressive Strength: Per Structural Drawings.
2. Maximum W/C Ratio: Per Structural Drawings.
3. Slump Limit: Per Structural Drawings.
4. Air Content: Per Structural Drawings..

2.11 FABRICATING REINFORCEMENT

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

2.12 CONCRETE MIXING

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

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

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

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

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.

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

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

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

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

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Do not chamfer exterior corners and edges of permanently exposed concrete.

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

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

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

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

3.2 EMBEDDED ITEM INSTALLATION

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

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install link-seal or prep surface for link-seal around pipe penetrations.

3.3 STEEL REINFORCEMENT INSTALLATION

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

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

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

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

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

3.4 JOINTS

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

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

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by MASS Engineer.

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

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

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

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

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

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FORMED SURFACES

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

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

3.7 FINISHING FLOORS AND SLABS

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

3.8 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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

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

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: Match slab strength.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.9 CONCRETE PROTECTING AND CURING

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

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

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

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

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

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.
c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than 28 days old.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.11 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

   1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

3.12 CONCRETE SURFACE REPAIRS

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

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

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

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

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

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

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

3.13 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Contractor will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Special Inspections:

1. Steel reinforcement placement.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.

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

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

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

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.

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

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to MASS engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by MASS engineer but will not be used as sole basis for approval or rejection of concrete.

12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by MASS engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by MASS engineer.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.14 PROTECTION OF LIQUID FLOOR TREATMENTS

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

END OF SECTION

SECTION 04 22 00 – CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Miscellaneous masonry accessories.

B. Related Requirements:

1. Section 07 62 00 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, finishes, colors, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.

C. Qualification Data: For testing agency.

D. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For masonry units, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Anchors, ties, and metal accessories.

E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

F. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

G. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of (Per Structural Drawings).
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
4. Finish: Exterior face of CMUs shall be split face (blocks that are entirely below grade may be smooth face at contractor’s option).
5. Color: Per owner or owner’s representative. Contractor shall submit manufacturer’s color options for review and selection.

2.5 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with

reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide color cement as required to produce mortar color that matches CMU color.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91/C 91M.

E. Mortar Cement: ASTM C 1329/C 1329M.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Aggregate for Grout: ASTM C 404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: Per Structural Drawings.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

2.8 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. For reinforced masonry, use portland cement-lime masonry cement or mortar cement mortar.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For reinforced masonry, use Type S.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

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

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar

and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Contractor shall allow inspectors access to scaffolding and work areas as needed to perform tests and inspections.

B. Testing Agency: Contractor will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

C. Special Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.

D. Testing Prior to Construction: One set of tests.

E. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.8 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.9 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION

SECTION 05 50 00 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Work included:

1. Metal Fabrications.

B. Products furnished, but not installed, under this Section:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related work:

1. Section 03 30 00 – Cast-in-Place Concrete for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 09 90 00 – Painting and Coating

1.2 SUBBMITTALS

A. Dimensional prints: shall be submitted for approval prior to fabrication.

1.3 PRODUCT DELIVERY STORAGE AND HANDLING

A. Deliver materials to the jobsite in good condition and properly protected against damage to finished surfaces.

B. Store material in a location and manner to avoid damage. Do not stack components. Lay out components on firm foundation material such that bending cannot occur.

C. Store metal components in a clean dry location, away from uncured concrete, cement, or masonry products, acids, oxidizers, rain water, or any other chemical or substance that might damage the material or finish.

D. Plan work and storage locations to keep on-site handling to a minimum.

E. Exercise particular care to avoid damage to material finishes or unprotected surfaces when handling.

1.4 JOB CONDITIONS

A. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

B. Refer to the construction documents, shop drawings, and manufacturer's installation instructions.

C. Observe all appropriate OSHA safety guidelines for this work.

1.5 WARRANTY/GUARANTEE

A. Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of (25) twenty five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge. Electrical motors, special finishes, and other special equipment (if applicable) shall be warranted separately by the manufacturers of those products.

B. Manufacturer's Quality System: Registered to ISO 9001:2008 Quality Standards including in-house engineering for product design activities.

1.6 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.8 QUALITY ASSURANCE

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

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
   1. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Per Structural Drawings.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers.

D. Anchor Bolts: Per Structural Drawings.

   1. Hot-dip galvanized or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Eyebolts: ASTM A 489.

F. Machine Screws: ASME B18.6.3.

G. Lag Screws: ASME B18.2.1.

H. Wood Screws: Flat head, ASME B18.6.1.

I. Plain Washers: Round, ASME B18.22.1.

J. Lock Washers: Helical, spring type, ASME B18.21.1.

K. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed

when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

L. Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.4 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.5 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.6 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless indicated.

PART 3 - EXECUTION

3.1 PREPARATIONS

A. Coordination: Coordinate start and installation of metal fabrications with performance and construction requirements, and in accordance with approved shop drawings or dimensional prints. Fabricate and shop-assemble to greatest extent possible.

B. Verification: Verify that dimensions and angles are correct and that substrate is in proper condition for metal fabrications installation. Do not proceed with installation until all necessary corrections have been made.

3.2 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.4 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 90 00 Painting and Coating.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

3.6 CLEAN-UP

A. Leave work areas clean and free of debris.

END OF SECTION

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Wood blocking and nailers.
3. Wood furring.

B. Related Requirements:

1. Section 06 16 00 - Sheathing

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

B. Exposed Framing: Framing not concealed by other construction.

C. OSB: Oriented strand board.

1.4 INFORMATIONAL SUBMITTALS

A. None.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

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

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 DIMENSION LUMBER FRAMING

A. Joists, Rafters, and Other Framing: Per Structural Drawings.

2.3 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.

B. Dimension Lumber Items: Per Structural Drawings.

C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.4 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

2.5 METAL FRAMING ANCHORS

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

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

B. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated of basis-of-design products of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

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

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.

2. Use copper naphthenate for items not continuously protected from liquid water.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

K. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with approved fastener patterns where applicable.
2. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 RAFTER FRAMING INSTALLATION

A. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

B. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather.

END OF SECTION

SECTION 06 16 00 – SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Floor sheathing.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.2 FLOOR SHEATHING

A. Plywood Sheathing: Exterior sheathing.

   1. Span Rating: Per Structural Drawings.
   2. Nominal Thickness: Per Structural Drawings.

B. Oriented-Strand-Board Sheathing: DOC PS 2, Exterior sheathing.

   1. Span Rating: Per Structural Drawings.
   2. Nominal Thickness: Per Structural Drawings.

2.3 FASTENERS

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

1. For floor sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

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

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

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

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

B. Fastening Methods: Fasten panels as indicated below:

1. Floor Sheathing:

a. Nail to wood framing.
b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION

SECTION 06 83 16 – FIBERGLASS REINFORCED PANELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.

B. Trim.

1.2 REFERENCE STANDARDS

A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels 2022.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023b.

1.3 SUBMITTALS

A. Submit in accordance with MASS Section 10.05 Article 5.6.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns, and colors available; and installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:

1. Crane Composites, Inc; Fire-X Glasboard Embossed Wall Panels | FXE : www.cranecomposites.com/#sle.
2. Substitutions: Submit in accordance with MASS Section 10.05 Article 5.7.

2.2 PANEL SYSTEMS

A. Wall Panels:

1. Panel Size: 4 by 8 feet.
2. Panel Thickness: 0.09 inch.

3. Surface Design: Embossed.
4. Color: White.
5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.3 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.

B. Trim: Vinyl; color coordinating with panel.

C. Adhesive: Type recommended by panel manufacturer.

D. Sealant: Type recommended by panel manufacturer; white.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

3.2 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

E. Install panels with manufacturer's recommended gap for panel field and corner joints.

F. Place trim on panel before fastening edges, as required.

G. Fill channels in trim with sealant before attaching to panel.

H. Install trim with adhesive and screws or nails, as required.

I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

SECTION 07 21 00 – THERMAL INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Board insulation at exterior wall behind CMU wall finish and roofing.

B. Foamed in place insulation around perimeter of door openings and other exterior wall penetrations.

1.2 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2022.

B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2023.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023b.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).

E. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies 2018.

1.3 SUBMITTALS

A. Submit in accordance with MASS Section 10.05 Article 5.6.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.4 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 - PRODUCTS

2.1 APPLICATIONS

A. Insulation on Inside of Concrete Masonry Unit Exterior Walls: Polyisocyanurate (ISO) board.

B. Insulation At Roof Deck: Extruded polystyrene (XPS) board.

2.2 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.

1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
3. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
4. Board Edges: Square.
5. Board Thickness: 5.5 inch.
6. Products:
   a. Owens Corning Corporation; FOAMULAR Type IV Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.
   b. Substitutions: Submit in accordance with MASS Section 10.05 Article 5.7.

B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, comply with ASTM C1289.

1. Classifications:
   a. Type I: Faced with aluminum foil on both major surfaces of the core foam.
      1) Class 1 - Non-reinforced core foam.
      2) Compressive Strength: 16 psi, minimum.
      3) Thermal Resistance, R-value: At 2 1/2 inch thick; 16.7, minimum, at 75 degrees F.
2. Flame Spread Index (FSI): Class B - 26 to 75, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Water Vapor Permeance: 0.03 perm, maximum, at 1 inch thickness, and when tested in accordance with ASTM E96/E96M, desiccant method.
5. Board Thickness: 2.5 inch.
6. Products:
   a. Johns Manville; AP Foil-Faced: www.jm.com/#sle.
   b. Rmax Inc; Thermasheath: www.rmax.com/#sle.
   c. Substitutions: Submit in accordance with MASS Section 10.05 Article 5.7.

2.3 FOAMED-IN-PLACE INSULATION

A. DOW Building Solutions; ENERFOAM Professional Foam Sealant.

1. Minimal Expanding.
2. Flexural Strength, ASTM C203, parallel to rise, psi: 8.8.
3. Apparent Initial k-factor (Thermal Resistance) per inch, ASTM C518 @ 75 degrees mean temp.: 0.26.
4. Compressive Strength, ASTM D1621, parallel to rise, psi: 9.3.
5. Apparent Density, ASTM D1622, pcf: 1.01.
6. Water Absorption, ASTM D2842, % volume: 3.03.
7. Open Cell Content, ASTM D2856, %: 20.

2.4 ACCESSORIES

A. Sheet Vapor Retarder: Clear polyethylene film for above grade application, 10 mil, 0.010 inch thick.

B. Tape: Polyethylene self-adhering type, 2 inch wide.

C. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install rigid insulation directly to CMU between z-furring at 16 inches on center with manufacturer recommended mechanical fasteners, and tape joints with manufacturer's minimum 4 inches wide sealant tape; comply with ASTM E2357.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 FOAMED-IN-PLACE INSULATION

A. Install at perimeter of door and window frames and other exterior wall penetrations to seal minor gaps between frame and rough opening.

B. Install at concealed locations only.

C. Install in accordance with manufacturers recommendations.

3.4 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 31 13 – ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Asphalt shingle roofing.

B. Flexible sheet membranes for underlayment.

1.2 REFERENCE STANDARDS

A. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing 2017 (Reapproved 2023).

B. ASTM D3462/D3462M - Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules 2023.

C. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings 2020a.

D. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples 2021a.

E. NRCA (RM) - The NRCA Roofing Manual 2023.

F. UL (DIR) - Online Certifications Directory Current Edition.

1.3 SUBMITTALS

A. Submit in accordance with MASS Section 10.05 Article 5.6.

B. Product Data: Provide data indicating material characteristics, performance criteria, and limitations.

C. Samples: Submit sample of shingle color/texture/pattern indicating match of existing shingles for final approval.

D. Manufacturer's Installation Instructions: Indicate installation criteria and procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store materials with labels intact in manufacturer's unopened packaging until ready for installation.

B. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.

C. Protect materials from harmful environmental elements, construction dust, direct sunlight, and other potentially detrimental conditions.

D. When storing roofing materials on roofing system ensure that no damage occurs to supporting members and other materials.

PART 2 - PRODUCTS

2.1 ASPHALT SHINGLES

A. Asphalt Shingles: Asphalt-coated glass felt, mineral granule surfaced, complying with ASTM D3462/D3462M.

1. Fire Resistance: Class A, complying with ASTM E108.
2. Fire or Wind Resistance Criteria: Provide UL (DIR) listed and labeled products.
3. Self-sealing type.
4. Style: Square.
5. Color: To match existing asphalt shingles.

2.2 SHEET MATERIALS

A. Underlayment: Asphalt-saturated organic roofing felt, unperforated, complying with ASTM D226/D226M, Type II, No. 30.

2.3 ACCESSORIES

A. Roofing Nails: Standard round wire shingle type, galvanized steel, minimum 3/8-inch head diameter, 12-gauge, 0.109-inch nail shank diameter, 1-1/2 inches long and complying with ASTM F1667/F1667M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions prior to starting this work.

B. Verify that roof deck is of sufficient thickness to accept fasteners.

C. Verify that roof penetrations and plumbing stacks are in place and flashed to deck surface.

D. Verify deck surfaces are dry, free of ridges, warps, or voids.

3.2 PREPARATION

A. Broom clean deck surfaces before installing underlayment or eave protection.

B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.3 INSTALLATION

A. Underlayment:

1. Roof Slopes Greater Than 4:12: Install underlayment perpendicular to slope of roof, with ends and edges weather lapped minimum 4 inches; stagger end laps of each consecutive layer, nail in place, and weather lap minimum 4 inches over eave protection.
2. Weather lap and seal watertight with plastic cement any items projecting through or mounted on roof.

B. Shingles:

1. Install shingles in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
   a. Fasten individual shingles using two nails per shingle, or as required by manufacturer and local building code, whichever is greater.
   b. Fasten strip shingles using four nails per strip, or as required by manufacturer and local building code, whichever is greater.
2. Complete installation to provide weathertight service.

END OF SECTION

SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, and sheet metal roofing.

B. Sealants for joints within sheet metal fabrications.

1.2 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

D. CDA A4050 - Copper in Architecture - Handbook current edition.

E. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.3 SUBMITTALS

A. Submit in accordance with MASS Section 10.05 Article 5.6.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 ROOF PANEL MANUFACTURERS

A. Metal Sales: 7/8" Corrugated Roof Panel; www.metalsales.us.com.

1. Panel Coverage: 32 inches.
2. Rib Height: 7/8 inch.

3. Material: Zinc-coated steel sheet, G90 coating, structural quality, Grade 50, 22 Gauge minimum thickness.
4. Attachment: Exposed, direct-fastened panel.
5. Finish: Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
6. Color: As selected by Architect from manufacturer's standard colors.

B. Substitutions: Submit in accordance with MASS Section 10.05 Article 5.7.

2.2 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch-thick base metal, shop pre-coated with PVDF coating.
1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coats, thermally cured fluoropolymer finish system.
2. Color: As selected by Architect from manufacturer's standard colors.

2.3 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2-inch, miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch-long legs; seam for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

2.4 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer Type: Zinc chromate.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 INSTALLATION

A. Secure flashings in place using exposed galvanized fasteners.

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Seal metal joints watertight.

END OF SECTION

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

1.2 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015 (Reapproved 2022).

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016 (Reapproved 2023).

D. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2022.

1.3 SUBMITTALS

A. Submit in accordance with MASS Section 10.05 Article 5.6.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
2. List of backing materials approved for use with the specific product.
3. Backing material recommended by sealant manufacturer.
4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
5. Substrates the product should not be used on.

C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Nonsag Sealants:

1. Bostik Inc: www.bostik-us.com/#sle.
2. Dow: www.dow.com/#sle.
3. Sika Corporation: www.usa.sika.com/#sle.
4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
5. Substitutions: Submit in accordance with MASS Section 10.05 Article 5.7.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints:
      a. Seal the following joints:
         1) Joints between doors, windows, and other frames or adjacent construction.
   2. Interior Joints:
      a. Seal the following joints:
         1) Joints between door frames and adjacent construction.
         2) In wall assemblies, gaps at electrical outlets, wiring devices, and piping penetrations.

2.3 NONSAG JOINT SEALANTS

A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 35 percent, minimum.
   2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Color: Match adjacent finished surfaces.
   5. Service Temperature Range: Minus 20 to 180 degrees F.

B. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
   3. Color: Match adjacent finished surfaces.
   4. Service Temperature Range: Minus 65 to 180 degrees F.

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

2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: Match adjacent finished surfaces.
4. Service Temperature Range: Minus 40 to 180 degrees F.

2.4 ACCESSORIES

A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

B. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

C. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

D. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION

SECTION 08 16 13 – FIBERGLASS DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fiberglass doors.

B. Fiberglass door frames.

1.2 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

1.3 REFERENCE STANDARDS

A. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2022.

B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2022.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023b.

D. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors, and Skylights 2023.

1.4 SUBMITTALS

A. Submit in accordance with MASS Section 10.05 Article 5.6.

B. Product Data: Provide manufacturer's standard details, installation instructions, hardware, and anchor recommendations.

C. Shop Drawings: Indicate layout and profiles; include assembly methods.

1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.
2. Indicate wall conditions, door and frame elevations, sections, materials, gauges, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on drawings to identify details and openings.

D. Manufacturer's qualification statement.

E. Maintenance Data: Include instructions for repair of minor scratches and damage.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.

1. Store at temperature and humidity conditions recommended by manufacturer.
2. Do not use non-vented plastic or canvas shelters.
3. Immediately remove wet wrappers.

C. Store in position recommended by manufacturer, elevated minimum 4 inches above grade, with minimum 1/4-inch space between doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Molded Fiberglass Doors:

1. Tiger Door, LLC: Heavy Duty FRP Doors: www.tigerdoor.com.
2. Substitutions: Submit in accordance with MASS Section 10.05 Article 5.7.

2.2 DOOR AND FRAME ASSEMBLIES

A. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.

1. Operation: Manual.
2. Physical Endurance: Swinging door cycle test to ANSI/SDI A250.4, Level A (1,000,000 cycles) minimum; tested with hardware and fasteners intended for use on project.
3. Screw-Holding Capacity: Tested to 890 pounds, minimum.
4. Surface Burning Characteristics: Flame spread index (FSI) of 26 to 75, Class B, and smoke developed index (SDI) of 450 or less, when tested in accordance with ASTM E84.
5. Flammability: Self-extinguishing when tested in accordance with ASTM D635.
6. Chemical Resistance: Resist degradation due to exposure to tap water and distilled water.
   a. Sewage and moisture-laden air in sewage treatment areas.
   b. Ocean salt spray.
7. Sizes: As indicated on drawings.
8. Clearance Between Door and Frame: 1/8 inch, maximum.
9. Clearance Between Bottom of Door and Finished Floor: 3/4 inch, maximum; not less than 1/4-inch clearance to threshold.

2.3 COMPONENTS

A. Doors: Fiberglass construction with reinforced core.

1. Type: As indicated on drawings, including swinging, and sliding doors.
2. Thickness: 1-3/4-inch, nominal.
3. Core Material: Manufacturer's standard core material for application indicated.
4. Construction:
   a. Molded in one piece including through color gel coating on each side; manufacturer's standard subframe, core and faces fused during curing; hardware reinforcements.
5. Face Sheet Texture: Smooth.
6. Door Panel Configuration: As indicated on drawings.
7. Subframe and Reinforcements: Manufacturer's standard materials.
8. Waterproof Integrity: Provide factory fabricated edges, cut-outs, and hardware preparations of fiberglass reinforced plastic (FRP); provide cut-outs with joints sealed independently of glazing, louver inserts, or trim.
9. Hardware Preparations: Factory reinforce, machine, and prepare for door hardware including field installed items; provide solid blocking for each item; field cutting, drilling or tapping is not permitted; obtain manufacturer's hardware templates for preparation as necessary.

B. Door Frames: Provide type in compliance with performance requirements specified for doors.

1. Type: Factory assembled with chemically welded joints.
2. Profiles: As indicated on drawings.
3. Door Stop: 5/8 inch wide, by 1-7/8 inches deep.
4. Non-Fire-Rated:
   a. Fiberglass reinforced plastic (FRP) with gel-coating matching doors.
5. Corner Joints: Mitered with concealed corner blocks or angles of same material as frame; fiberglass and aluminum joined with screws; steel and stainless-steel spot welded; sealed watertight with silicone sealant; field assemble knock-down type frames as required.
6. Hardware Cut-outs: Provide continuous backing or mortar guards of same material as frame, with watertight seal.
7. Frame Anchors: Stainless steel, Type 304; provide three anchors in each jamb for heights up to 84 inches with one additional anchor for each additional 24 inches in height.
8. Reinforcing: Provide manufacturer's standard reinforcing at hinge, strike, and closer locations.

2.4 FINISHES

A. Painted: Two-part aliphatic polyurethane, low VOC industrial coating.

1. Thickness: Minimum 3-4 mils wet thickness.
2. Color: As selected by Architect from manufacturer's standard line of colors.

2.5 HARDWARE

A. Door Hardware: See Section 08 71 00.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

3.2 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

B. Clean and prepare substrate in accordance with manufacturer's directions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions; do not penetrate frames with anchors.

B. Install exterior doors in accordance with ASTM E2112.

C. Install door hardware as specified in Section 08 71 00.

D. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances, anchor in place.

E. Separate aluminum and other metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.

F. Repair or replace damaged installed products.

3.4 ADJUSTING

A. Lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion, and to fit watertight for entire perimeter.

B. Adjust hardware for smooth and quiet operation.

C. Adjust doors to fit snugly and close without sticking or binding.

3.5 CLEANING

A. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

END OF SECTION

SECTION 08 71 10 – DOOR HARDWARE

PART 1 – GENERAL

1.1 PRODUCTS FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Templates and other installation data required prior to hardware delivery, or at fabricators located off the job site. Furnish in a timely manner per construction schedule.

1.2 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this Specification. Publications may be referred to in the text by basic designation only. In case of conflict the most stringent shall govern:
   a. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA) A156 series as specified.
   b. American Society of Testing and Materials (ASTM) ASTM D1056 - Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
   c. ASTM D2497 - Tolerances for Man-Made Organic Base Filament Single Yarns.
   d. International Building Code (IBC).

1.3 PERFORMANCE REQUIREMENTS

A. When manufacturer and model number is given, it shall be used to establish minimum equivalent technical data and performance requirements for other manufacturers unless "no substitute" is specified.

B. Substitutions per General Requirements.

1.4 SUBMITTALS

A. Samples may be required for any proposed alternatives to hardware listed to establish equivalency. Samples will be returned after inspection.

B. List Manufacturers, model numbers, key schedule, and location and mounting heights of hardware in completed work. Use Contract Document door designations.

C. Provide abbreviation legend for abbreviations

D. List each door opening separately.

E. Maintenance - Adjustment Manuals and parts lists with name and telephone number of stock location.

F. Indicate location of closers on doors and frames.

G. Supply templates to door and frame manufacturers to enable proper sizing and locations of cut outs and reinforcements for hardware.

H. Manufacturers experience qualifications.

1.5 QUALITY ASSURANCE

A. Manufacturers: Companies specializing in commercial building hardware in the U.S. for the past 10 years minimum.

1.6 MANUFACTURER ASSISTANCE

A. Provide assistance of the finish hardware supplier representative knowledgeable in the system specified for the following:
   a. Pre-Construction Conference: minimum 1 hour.
   b. Final Installation and adjustment and maintenance training of Door Hardware.

1.7 PACKAGING AND MARKING

A. Single group of hardware packaged separately for each opening complete with all necessary accessories, fasteners, key instruction and templates.

B. Mark each package with a group number corresponding to the approved hardware schedule identifying its contents and location in the completed work.

1.8 DELIVERY AND STORAGE

A. Hardware shall be checked upon arrival to job site and acceptance verified by the CONTRACTOR'S Representative in writing.

B. Hardware shall be adequately protected from corrosion and pilferage until acceptance of building.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers are named to provide standard of quality and are subject to specified criteria.

2.2 FINISHES

A. ANSI A156.18 No. 630 Satin Stainless Steel (US 32D Stainless Steel, satin

finish).

B. Matte Aluminum paint for door closers.

C. Mill finish aluminum for weatherstrip and gasket seal mounts.

2.3 MOUNTING ACCESSORIES

A. Screws, bolts, escutcheons, brackets and similar supplemental items as necessary and recommended by manufacturer for conditions of use for complete functional use. Provide stainless steel fasteners which are compatible with both hardware and substrate, and which will not cause dissimilar metal corrosion. Mount surface hardware on doors with shouldered thru-bolts.

2.4 BUTT HINGES

A. Full mortise, stainless steel with stainless steel pins:

B. Heavy weight hinges not less than 0.180 inches thick on exterior doors, doors over 3 feet wide, and doors over 100 pounds.

C. Doors up to 7 feet high shall have 3 hinges.

D. Provide ball bearing hinges on doors with closers.

E. Hinges on lockable doors shall have non-removable pins secured with setscrew in barrel or other method tamperproof when door is closed.

F. Width of hinges shall be sufficient to clear trim detail conditions and provide up to 180-degree door swing or until door returns to adjacent wall.

G. 4-1/2 inch minimum height of hinges.

2.5 EXIT DEVICE

A. Horizontal Surface Touch Bar: Von Duprin 98 Series.
   a. Rim Type.
   b. Outside Trim on Pull Side: Round bar lever handle operation with vandal resistant breakaway or free wheeling feature 10 gage plate trim Von Duprin 990, and key cylinder lock. Lever handle curved to within ½ inch of door face: Von Duprin No. 03.
   c. U.L. listed as accident – panic hardware.
   d. Cylinder: Medeco XT combination mechanical key and electronic intelligent key way, compatible with keying system.
   e. Provide cylinder-dogging device.
   f. Roller strike plate.

2.6 KEYING

A. Provide keying system as directed by the CONTRACTING OFFICER. The CONTRACTOR shall have a qualified representative of the hardware supplier available for the purpose of establishing Keyed Products.

B. Provide 6 cut keys and 6 Medico XT electronic intelligent keys for each cylinder lock.

C. Provide 6 Medico XT electronic intelligent keys for gate padlock.

D. Provide interchangeable core construction keying. Only construction keys allowed during construction.

E. Stamp conventional metal keys “DND”.

2.7 CLOSERS

A. Positive pressure cast iron shell with steel rack and pinion-piston type surface mount rectangular enclosure.
   a. Non-handed, field adjustable for interior and exterior doors to 48 inch wide.
   b. Rated for heavy duty high-use for door sizes indicated by manufacturer: LCN 4000, or Stanley QDC 100 series.

B. Adjustable closing speed, 3 second minimum from 70 degrees to 3 inches from the latch for accessible use. Separate adjustable latching speed and separate adjustable back check.

C. Through mounting bolts with spacers or sex bolts and mounting bracket adaptors as necessary for door and frame conditions. Security screws into threaded backing.
   a. Special extra clearances mount arms so that weather seals and smoke seals are not cut, and provide clearance for overhead stops.

D. Fire resistant and low temperature fluid for satisfactory operation to 30 degrees F and no permanent damage if subjected to minus 30 degrees F.

2.8 DOOR KICK PROTECTION PLATES

A. Stainless steel, at least 0.05 inch thick and 2 inches less than door width, or as required to fit door seals per ANSI A156.6.

B. Kick plates: 10 inches high.

2.9 THRESHOLDS

A. Exterior: Extruded aluminum full width single piece at exterior openings. 6 inch by 1/4 inch saddle with beveled edges and fluted top with integral plastic

thermal barrier in accord with ANSI/BHMA A156.21, PEMKO 250 Series, Zero, Reese or equivalent.

B. Fasten thresholds with countersunk-head screws 12-inches spacing maximum: provide two screw rows for thresholds over 6-inches wide.

2.10 WEATHERSTRIPPING

A. Dense layered plastic bristle brush weather strip. Brush fibers fused into place, flexible at minus -30 degrees F. held in extruded aluminum holder-mount with pre-punched pre-slotted holes for mounting with screws. Mount on inside warm face. ANSI and PEMKO Corporation numbers listed, equivalent Sealeze, or Zero acceptable.

B. Full-length single piece.

C. Door head and Side Jambs: 45-degree angle mount, 3/8 inch brush ANSI R3A36 PEMKO 45041.

D. Door Bottom: 1-inch brush; ANSI R3A415 PEMKO 181

2.11 OVERHEAD DOOR STOP

A. Overhead with a separate check-stop and hold-open recommended for exterior heavy duty use; stainless steel or chrome plated extruded bronze and brass 85 to 110 degrees opening; shock absorber: Corbin Russwin, Glynn Johnson, Rixon or equal.

2.12 GATE PADLOCK

A. Assa Abloy Medico XT padlock.

PART 3 – EXECUTION

3.1 EXAMINATION

A Examine the DRAWING details and field conditions for defects that will adversely affect the work, and for deviations beyond allowable tolerances.

B. Beginning of installation shall mean acceptance of the interfacing surfaces as capable of producing an acceptable job.

3.2 SOLID BACKING

A. Provide within structure and doors for hardware mounting, including wall

doorstops and closers. Coordinate as required during construction. Provide special mounting accessories, built-in if required.

3.3 MOUNTING LOCATIONS

A. Per ANSI A117.1 – Accessible Buildings approved submittals, manufacturer's standard practice and coordinated with door and frame manufacturer.

B. Mount closers on interior side of exterior.

C. Mount resilient weatherstrip on inside of door assembly to form vapor retarder.

3.4 INSTALLATION

A. In accord with applicable ANSI standards, approved submittals, the manufacturer's written instructions and ADAG for the conditions of use. Install closers and closer arm with bolts through doors.

B. Do not install surface mounted items until finishes are completed on substrate. Coordinate as necessary. Remove hardware after fitting if necessary for painting and reinstall.

C. Apply exterior hardware and thresholds with gaskets or in continuous silicone sealant bed. Do not cut weather seal at closers.

3.5 FINAL ADJUSTMENT

A. Per manufacturer's written instructions, including, cleaning and lubrication to meet ADAG.

A. Adjust doors, compensating for completed, operating heating and vent system. Latches and bolts shall engage keepers in latched position and not rattle.

B. Doors with closers shall close and latch without assistance.

C. Doors shall open and close smoothly and easily with 1 hand. Weather seals shall be in continuous contact in latched position.

3.6 CLEANING

A. Remove shipping labels and leave hardware surfaces clean.

3.7 TYPICAL HARDWARE SETS

A. Include any special maintenance adjustment tools necessary.

B. Refer to DRAWINGS for locations and details.

3.8 DOOR HARDWARE SCHEDULE

Hardware Set 1: Opening to Exterior:
3 Butt Hinges
1 Exit Device
1 Closer
1 Overhead Door Stop
1 Kickplate
1 Threshold
1 Set Weather Seals

END OF SECTION

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal stud wall framing.

B. Gypsum wallboard.

C. Joint treatment and accessories.

1.2 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing 2020.

B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing 2015, with Errata (2020).

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.

D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members 2015.

E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.

F. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).

G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.

H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.

I. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2022.

J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.

K. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.

L. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.

M. GA-216 - Application and Finishing of Gypsum Panel Products 2021.

1.3 SUBMITTALS

A. Submit in accordance with MASS Section 10.05 Article 5.6.

B. Product Data:

1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Manufacturers - Metal Framing, Connectors, and Accessories:

1. ClarkDietrich: www.clarkdietrich.com/#sle.
2. SCAFCO Corporation: www.scafco.com/#sle.
3. Substitutions: Submit in accordance with MASS Section 10.05 Article 5.7.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.

1. Studs: C-shaped with knurled or embossed faces.
2. Runners: U shaped, sized to match studs.
3. Ceiling Channels: C-shaped.
4. Flexible Track: Flexible framing consisting of adjustable leg straps and pivoting, hinged track brackets designed to provide curved framing assemblies of varying radii.

D. Partition Head to Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and screwed to secondary deflection channel set inside but unattached to top track.

E. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.

F. Non-structural Framing Accessories:

1. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
2. Drywall Corner Clips: Drywall clips help support drywall to reduce wood blocking on top plates, end walls, and corners.

2.2 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:

1. American Gypsum Company: www.americangypsum.com/#sle.
2. CertainTeed Corporation: www.certainteed.com/#sle.
3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
4. Gold Bond Building Products, LLC provided by National Gypsum Company : www.goldbondbuilding.com/#sle.
5. USG Corporation: www.usg.com/#sle.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Thickness:
   a. Vertical Surfaces: 5/8-inch, Type 'X'.
   b. Ceilings: 5/8-inch, Type 'X'.

2.3 GYPSUM BOARD ACCESSORIES

A. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.

1. Corner Beads: Low profile, for 90 degrees outside corners.

B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

1. Paper Tape: 2 inch wide, creased paper tape for joints and corners.
2. Joint Compound: Drying type, vinyl-based, ready-mixed.

C. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

D. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

E. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

C. Studs: Space studs at 16 inches on center.

1. Extend partition framing to structure where indicated and to ceiling in other locations.
2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

3.3 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Installation on Metal Framing: Use screws for attachment of gypsum board.

D. Installation on Wood Framing: For nonrated assemblies, install as follows:

1. Single-Layer Applications: Screw attachment.

3.4 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:

1. Not more than 30 feet apart on walls and ceilings over 50 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

3.5 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:

1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
2. Level 3: Walls to receive textured wall finish.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

1. Feather coats of joint compound so that camber is maximum 1/32 inch.

END OF SECTION

SECTION 09 90 00 – PAINTING AND COATING

PART 1 GENERAL

1.1 DESCRIPTION

A. The Work of this section consists of furnishing and applying paint for miscellaneous non-galvanized ferrous surfaces. Galvanized ferrous surfaces and stainless steel surfaces will not be painted.

1.2 SUBMITTALS

A materials list and samples shall be submitted as required by MASS Section 10.05 Article 5.6 Product Data and as follows:

A. Materials list naming each product to be used identified by manufacturer and type number.

B. Volatile organic compound (VOC) level (gm/l) and manufacturer's certification of compliance with applicable air quality limits for each coating.

C. Manufacturer's application recommendations for each product submitted.

D. The Contractor shall submit a current chart of the Manufacturer's available colors for selection by the Engineer, 30 days prior to the start of coating and painting. Samples, when reviewed and accepted by the Engineer, shall establish the quality of the painted surface where these applications are indicated.

E. The Owner shall select colors from the submittal information presented.

1.3 DEFINITION

The term "paint" as used herein includes enamels, paints, sealers, emulsions and other coatings used as prime intermediate or finish coats for protection or decoration.

1.4 COMPLIANCE WITH VOLATILE ORGANIC COMPOUND (VOC) LIMITS

All paint and coating products shall comply with the applicable limits on volatile organic compounds (VOC) as established by the United States Environmental Protection Agency and by State and local air quality regulating agencies. It shall be the Contractor's responsibility to verify compliance of all paints and coatings. In the event that any paint or coating listed herein is found to be non-compliant, the Contractor shall notify the Engineer and the Engineer will select a substitute coating or paint.

1.5 QUALITY ASSURANCE

A. General: Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration

of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards and are approved by the Engineer.

B. Workmen: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

C. Paint Coordination:

1. Review other Sections of these Specifications as required, verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrata.

2. Upon request, furnish information on the characteristics of the specific finish materials to assure that compatible prime coats are used.

3. Provide barrier coats over non-compatible primers, or remove the primer and re-prime as required.

4. Notify the Engineer in writing of anticipated problems in using the specified coating systems over prime-coatings supplied under other Sections.

1.6 DELIVERY AND STORAGE

A. All materials shall be brought to the job site in original sealed containers. Each container shall bear the manufacturer's name, coating type, batch number, date of manufacture, storage life, and special directions. They shall not be used until the Engineer has inspected contents and obtained data from information on containers or label. Materials exceeding storage life recommended by the manufacturer shall be rejected.

B. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings or paints must be stored to conform with City, State and Federal safety codes for flammable coatings or paint materials. At all times coatings or paints shall be protected from freezing.

1.7 REFERENCED SPECIFICATIONS AND STANDARDS

A. Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating and painting of surfaces shall conform to the applicable requirements of the National Association of Corrosion Engineers, the Steel Structures Painting Council, and the Manufacturer's printed instructions.

B. The Engineer's decision shall be final as to interpretation and/or conflict between any on the reference specifications and standards contained herein.

1.8 AS COATED SUMMARY SHEET

Contractor shall supply a list of all the coating products used on the Project, including the

exact stock number and the file numbers for the color tints added and amounts for each. The Summary Sheet should also list the local paint supply location for the particular brand of coating including the Name, address, phone number, and website for each product.

PART 2 MATERIALS

2.1 PAINT AND FINISH PRODUCTS

A. Paint and coating products shall be fresh and well ground; shall not settle readily, cake, or thicken in the container; shall be broken up readily with paddle to a smooth consistency; and shall have easy application properties. Other painting materials such as linseed oil, turpentine, mineral spirits, miscellaneous thinners, varnish, and shellac shall be of the highest quality.

B. All paints and coatings shall be specifically manufactured for use on projects of this type, and shall be used on surfaces intended by the paint manufacturer. Paints and coatings shall be Tnemec or approved equal. All paint and coatings shall be delivered in original containers, with seals unbroken.

C. To establish a standard of quality, several specific paint and coating products are listed in the coating System Index under 2.4, this section.

2.2 COMPATIBILITY OF SHOP AND FIELD PAINTS

To ensure a satisfactory painting job it is essential that the paints applied in the shop and in the field be mutually compatible. Where prime coats are shop applied, the Contractor shall instruct suppliers to provide compatible primers with the finish coats selected by the Contractor. In no case will primers be allowed that are not manufactured by the suppliers of the finish coats unless approved by the Engineer.

2.3 COLORS

A. Color for the various surfaces to be painted shall be selected by the Engineer. Use of different colors for the various structures or for surfaces of a single structure may be directed by the Engineer.

2.4 SYSTEMS

The coating systems in this section are for coatings manufactured by the Sherwin-Williams Company. The acceptance of “or equal” manufacturer’s products is at the sole discretion and approval of the Owner. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer. The following index lists the various painting and coating systems by generic type:

Paint Coatings System Index

System ID.	Prime Coat	Intermediate Coat	Finish Coat
A.	Polyamide Epoxy (1 coat at 4-6 mils DFT)	Aliphatic Acrylic Polyurethane (1 coat at 3-5 mils DFT)	Aliphatic Acrylic Polyurethane (1 coat at 3-5 mils DFT)
B.	Amine Cured Epoxy (1 coat at 3-5 mils DFT)	Amine Cured Epoxy (1 coat at 3-5 mils DFT)	Amine Cured Epoxy (1 coat at 3-5 mils DFT)

A. System A – Exposed Ferrous Metal, Atmospheric Weathering:

1. Schedule/Service: For use with exposed miscellaneous metals or pipes subjected to water, condensation, or atmospheric weathering including pipes in ERA Vault. Do not paint surfaces in contact with potable water.
2. Generic Type(s): Polyamide Epoxy / Aliphatic Acrylic Polyurethane.
3. Surface Preparation: SSPC SP-6.
4. Prime Coat: 1 coat DURA-PLATE 235 Multi-Purpose Epoxy, 4 – 6 DFT.
5. Intermediate Coat: 1 coat Acrolon 218 HS Polyurethane, 3 – 5 DFT. Tint different shade from Finish Coat.
6. Finish Coat: 1 coat Acrolon 218 HS Polyurethane, 3 – 5 DFT. Tint different shade from Intermediate Coat.
7. Total System: 10 – 16 mils total dry film thickness (DFT).

B. System B – Below Grade Ferrous Metal:

1. Schedule/Service: Below grade metal such as structural steel. Do not paint surfaces in contact with potable water.
2. Generic Type(s): Amine Cured Epoxy, minimum 83% volume solids.
3. Surface Preparation: SSPC-SP-10 (Near White Blast Cleaning).
4. Prime Coat: 1 coat DURA-PLATE 235 Multi-Purpose Epoxy, 3-5 DFT. Color different from Intermediate and Finish Coats.
5. Intermediate Coat: 1 coat DURA-PLATE 235 Multi-Purpose Epoxy, 3-5 DFT. Tint different shade from Finish Coat.
6. Finish Coat: 1 coat DURA-PLATE 235 Multi-Purpose Epoxy, 3-5 DFT. Tint different shade from Intermediate Coat.
7. Total System: 9-15 mils total dry film thickness (DFT).

PART 3 EXECUTION

3.1 GENERAL

A. During scheduled coating periods, daily weather reporting is required (including, but not limited to, air and surface temperature, dew point, relative humidity, rain, snow, mist, fog, and wind. Further, daily reports shall include conditions that have the potential to cause dust, insects, or debris adhere to coating.) Contractor is required to obtain preauthorization from Owner's representative and Engineer prior to coating and painting; authorization shall be whether dependent. At all times, Contractor shall comply with paint manufacturer's published recommendation for environmental conditions in which paint materials can be applied and as approved by the Engineer.

B. All surface preparation, coating and painting shall conform to applicable standards of the National Association of Corrosion Engineers, the Steel Structures Painting Council, and the Manufacturer's printed instructions. Material applied prior to approval of surface by the Engineer shall be removed and re-applied to the satisfaction of the Engineer at the expense of the Contractor.

C. All Work shall be performed by skilled craftsmen qualified to perform the required Work in a manner comparable with the best standards of practice.

D. The Contractor shall provide a supervisor at the Work site during cleaning and application operations. The supervisor shall have the authority to sign any change orders, coordinate Work and make decisions pertaining to the fulfillment of the contract.

E. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.

F. Coatings and painting systems include surface preparation, prime coating and finish coatings. Unless otherwise specified, prime coatings shall be field applied. Where prime coatings are shop applied, the Contractor shall instruct suppliers to provide the prime coat compatible with the finish coat specified. Any off-site Work which does not conform to the specification is subject to rejection by the Engineer.

G. Shop applied prime coatings which are damaged during transportation, construction or installation shall be thoroughly cleaned and touched up in the field as directed by the Engineer. The Contractor shall use repair procedures which insure the complete protection of all adjacent primer.

H. The specified repair method and equipment may include wire-brushing, hand or power tool cleaning or dry air blast cleaning. In order to prevent injury to surrounding painted areas blast cleaning may require use of lower air pressure, smaller nozzle and abrasive particle sizes, short blast nozzle distance from surface, shielding and masking. If damage is too extensive, the item shall be re-cleaned and coated or painted as directed by the Engineer.

I. Previously painted surfaces: Repair surface defects. Remove grease, oil and other contaminants as specified for steel surfaces. Scrape carefully to remove deteriorated coatings. Glossy or very hard coatings should be prepared in accordance with SSPC SP-3 to promote maximum adhesion of the subsequent coating. Surface must be thoroughly dry before coating.

J. The Contractor's coating and painting equipment shall be designed for application of materials and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Contractor's equipment shall be subject to approval by the Engineer.

K. Application of the first coat shall follow immediately after surface preparation and cleaning and within an eight hour working day. Any cleaned areas not receiving first coat within eight-hour period shall be re-cleaned prior to application of first coat; this may include re-blasting. Alternatively, apply an additive to prevent flash rust such as Holdtight 102.

L. Prior to assembly, all surfaces made inaccessible after assembly shall be prepared as specified herein and shall receive the coating or paint system specified.

3.2 SURFACE PREPARATION, METALLIC SURFACES

A. Surface preparation will be based on comparison with: "Pictorial Surface Preparation Standards for Painting Steel Surfaces", SSPC-Vis 1, ASTM Designation D220: "Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces", SSPC-Vis 2, ASTM Designation D610; Visual Standard for Surfaces of New Steel Air-blast Cleaned with Sand Abrasive", NACE Standard TM-01-70; and as described below. Anchor profile for prepared surfaces shall be measured by use of a non-destructive instrument such as a Keane-Tator Surface Profile Comparator or Testex Press-O-Film System.

To facilitate inspection the Contractor shall, on the first day of abrasive blast cleaning operations, blast clean metal panels to the standard specified. These panels shall be equivalent to the supplied plate stock which is to be coated or painted and shall have minimum measurements of 8-½-inches by 11-inches. After agreeing a specific panel meets the requirements of the specification, it shall be initialed by the Contractor and Engineer and coated with a clear non-changing finish. Panels shall be utilized for inspection purposes throughout the duration of blast cleaning operations.

B. Heavy deposits of grease or oil shall be removed with solvent oil cleaner and any chemical contamination shall be neutralized and/or flushed off prior to any other surface preparation.

C. Surfaces scheduled for Near White or Commercial Blast Cleaning shall have all welds, edges, and sharp corners ground to a 1/16-inch radius and all weld splatter removed, and sandblasted in accordance with Steel Structures Painting Council Specifications, removing mill scale, rust, dirt, paint, or other foreign matter, and shall be slightly roughened to form a suitable anchor pattern for the coating

application. Do not leave blasted surfaces overnight before coating. Remove all sand from the surface by brush or industrial vacuum.

D. All other steel not scheduled for blast cleaning shall have all weld splatter removed, and rough edges and rough welds ground, and shall be cleaned by means of hand or power tools, in accordance with Steel Structures Painting Council Specification No. 2 or No. 3, removing all loose mill scale rust, dirt, paint, or other contaminants. Blast cleaning may be used if practical. The remaining mill scale, rust, and paint must be sufficiently abraded to provide for good bonding of the coating.

E. Field blast cleaning for all surfaces shall be dry method unless otherwise directed.

F. Particle size of abrasives used in blast cleaning shall be that which will produce a 2 mil (50.0 microns) surface profile or in accordance with recommendations of the manufacturer of the specified coating or paint system to be applied.

G. Abrasive used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused unless specifically approved by the Engineer.

H. During blast cleaning operations, caution shall be exercised to insure that existing coatings or paints are not exposed to abrasion from blast cleaning.

I. The Contractor shall keep the area of his work in a clean condition and shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to performance of work or operation of existing facilities.

J. Blast cleaned surfaces shall be cleaned prior to application of specified coatings or paints by a combination of blowing with clean dry air, brushing/brooming and/or vacuuming as directed by the Engineer.

K. All welds shall be cleaned with a suitable chemical compatible with the specified coating materials.

L. Specific Surface Preparation: Surface preparation for the specific system shall be as designated in the Systems Index, Part 2.4 of this specification section and follow the recommended surface preparation per the product data sheets.

M. Application SSPC specifications are as follows:

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.

2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding, and wire-brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by power wire-brushing, power impact tools or power sanders.

4. White Metal Blast Cleaning (SSPC-SP5): Blast cleaning to a gray-white uniform metallic color until each element of surface is free of all visible residues.

5. Commercial Blast Cleaning (SSPC-SP6): Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.

6. Brush-off Blast Cleaning (SSPC-SP7): Blast cleaning to remove loose rust, loose mill scale and other detrimental foreign matter to degree specified.

7. Near White Blast Cleaning (SSPC-SP10): Blast cleaning to nearly white metal cleanliness, until at least 95 percent of each element of surface area is free of all visible residues.

3.3 COATING APPLICATION

A. Coating and paint application shall conform to the requirements of the Steel Structures Painting Council Paint Application Specifications SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting", and recommended practices of the National Association of Corrosion Engineers, and the Manufacturer of the paint and coating materials.

B. Before applying any paint or finish, all surfaces shall be thoroughly cleaned and prepared for painting as herein specified. All cleaned metal shall be primed or painted, as specified, immediately after cleaning to prevent new rusting or oxidation of cleaned surfaces.

C. Protective coverings or drop cloths shall be use to protect floors, fixtures, and equipment. Care shall be exercised to avoid lapping on glass or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.

D. Application – Environmental Conditions:

1. Do not paint surfaces that exceed manufacturer specified moisture contents.

2. Do not paint or coat:

a. Under dusty conditions.

b. When light on surface measures less than 15 foot-candles.

c. When ambient or surface temperature is less than 40 degrees Fahrenheit.

d. When relative humidity is higher than 85 percent.

e. When surface temperature is less than 5 degrees Fahrenheit above dew point.

f. When surface temperature exceeds the manufacturer's recommendation.

g. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.

3. No coating work shall be done under unfavorable weather conditions to wet or damp surfaces or in rain, snow, fog or mist.

4. When it is expected the air temperature will drop below 40 degrees F or less than 5 degrees F above the dewpoint within eight hours after application of coating or paint.

   Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with the US Department of Commerce Weather Bureau Psychometric Tables.

   If above conditions are prevalent, coating or painting shall be delayed or postponed until conditions are favorable, unless conditions are acceptable to the paint manufacturer for any given coating. The days coating or painting shall be completed in time to permit the film sufficient drying time to prevent damage by atmospheric conditions.

5. Provide fans, heating devices, dehumidifier unit, or other means recommended by coating manufacturer to prevent formation of condensation or dew on surface of substrate, coating between coats and within curing time following application of last coat.

6. Provide adequate continuous ventilation and sufficient heating facilities to maintain minimum 45 degrees Fahrenheit for 24 hours before, during and 48 hours after application of finishes.

E. All painting shall be well applied, leaving no sags, laps, brush, or other defects. Each coat must thoroughly dry before applying next coat, and all work must be carefully cut into a true line and left smooth and clean. Hardware trim and other items shall be removed as required for proper application of coatings.

1. All painting shall conform to the following general conditions:

   a. Thickness of coating in mils shall mean the dry film thickness. The number of coats specified shall mean the minimum number of coats to be used. Additional coatings shall be required if necessary to obtain the specified film thickness.

   b. No coating work shall be done under unfavorable weather conditions.

   c. Prime coats shall be provided where called for as a part of the painting system. Shop prime coats shall conform to the specified painting system for the given item. It shall be the responsibility of the Contractor to coordinate work so that factory prime items are primed or painted with a coating compatible with the specified finish painting system.

   d. Particular attention shall be given to all welds, edges, and corners so as to get full and adequate coverage. Damaged shop prime coats or field applied prime coats shall be carefully replaced before finish painting.

Surface preparation for replacement of damaged coats shall be such as to give a clean surface for proper bonding of prime coat. Surfaces shall be strip coated per SSPC PA1 section 2.1,6.6. Finish coatings shall not be applied until touch-up prime coat has completely dried.

e. Minimum between-coat drying items, as stated in the printed instructions of the coating manufacturer will be carefully observed.

f. Thinning shall be done only if necessary for workability of the coating material in accordance with the manufacturer's printed instructions. Use only the appropriate thinner.

g. Each coat shall be applied in a similar but different color from the preceding coat, the finish coat to be color selected by the Engineer.

3.4 INSPECTION

A. Inspection - General

1. Thickness of coatings and paints on metal surfaces shall be checked with a non-destructive type thickness gauge and shall follow the guidelines specified in SSPC-PA 2. Coating integrity shall be tested with an approved inspection device.

2. In cases of dispute concerning film thickness or holidays, the Engineer's calibrated instruments and measurements shall predominate. Wide film thickness discrepancies shall be measured and verified with a micrometer or other approved measuring instrument.

B. Inspection Devices

1. The Contractor shall furnish, until final acceptance of coating and painting, inspection devices in good working condition for measurement of dry-film thickness of coating and paint.

2. Dry-film thickness gauges and holiday testing device shall be made available for the Engineer's use at all times until final acceptance.

3.5 SAFETY AND HEALTH REQUIREMENTS

A. General: In accordance with requirements set forth by regulatory agencies applicable to the construction industry and Manufacturer's printed instructions and appropriate technical bulletins and manuals, the Contractor shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.

B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons in the vicinity of the Work. In addition, workers engaged in or near the Work during abrasive blasting shall wear eye and face protection devices and air purifying, half-mask or mouthpiece respirator with appropriate filter. Barrier creams shall be used on any exposed areas of skin.

C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminant to the degree a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

D. Sound Levels: Whenever the occupational noise exposure exceed maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protective devices.

E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Illumination shall be as provided in SSPC-Guide 12. Whenever required by the Engineer, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the Engineer.

F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the Engineer to facilitate inspection and be removed by the Contractor to locations requested by the Engineer.

3.6 PRESERVATION

During construction, painter shall assume the preservation of all his work against damage by accident or otherwise, and shall leave the Work clean and whole. The Work will not be accepted until all of the Work has been completed and all retouching has been done. All Work which is rejected, or for any reason has to be done over, will be done by the Contractor at his expense.

3.7 CLEANING

During the progress of the Work, all other work shall be covered and fully protected from injury or painter's finish, and care shall be exercised not to splatter paint, enamel, etc., on adjacent work. Upon completion of the Work, all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the Engineer. Name and data plates on equipment shall not be painted and shall be left clean and legible upon completion of the project. All damage to surfaces resulting from the Work of this section shall be cleaned, repaired, or refinished to the satisfaction of the Engineer at no expense to the Agency.

3.8 SURFACES REQUIRING PAINTING

In general, the following surfaces are to be coated or painted:

A. Exposed non-galvanized ferrous metal surfaces.

B. Below grade metal surfaces.

3.9 SURFACES NOT REQUIRING PAINTING

A. Galvanized surfaces.

B. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials will not require painting under this Section except as scheduled.

C. Portions of metal embedded and contacting concrete, except for aluminum surfaces.

D. Electrical equipment with factory applied finish.

E. Do not paint moving parts of operating units; mechanical or electrical parts such as valve operators; linkages; sensing devices; and motor shafts, unless otherwise indicated.

F. Do not paint over required labels or equipment identification, performance rating, name, or nomenclature plates.

END OF SECTION

SECTION 09 91 00 – BUILDING PAINTING

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this Specification. Publications may be referenced in the text by basic designation only. In case of conflict the most stringent apply.

1. ASTM C 1026 – Test Method for Determining the Static Coefficient of Ceramic Tile and Other Like Surfaces by the Horizontal Dynometer Pull-Meter Method.
2. ASTM D16 – Standard Terminology for Paint Related Coatings, Materials, and Applications.
3. ASTM D610 – Practice for Evaluating Degree of Rusting on Painted Steel Surfaces.
4. ASTM D714 – Test Method for Evaluating Degree of Blistering of Paints.
5. ASTM D2486 – Test Method for Scrub Resistance of Wall Paints
6. ASTM D3359 – Standard Test Methods for Measuring Adhesion by Tape Test.
7. ASTM D4442 - Test Method for Direct Moisture Content Measurement of Wood and Wood-Base Materials
8. ASTM D6677 – Standard Test Method for Evaluating Adhesion by Knife.
9. Society for Protective Coatings/Steel Structures Painting Council (SSPC) - Standards and Specifications.

1.2 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.3 SUBMITTALS

A. Provide product data on all coating and finishing products; indicating application instructions including: surface preparation, undercoating,

reducing, and certification that product is “Best Line - Premium Grade”.

B. Submit manufacturer and applicator experience data.

1.4 QUALITY ASSURANCE

A. Product Manufacturer: Company specializing in manufacturing paint and coating finish products with 25 jobs similar in scope to work proposed.

B. Applicator: Specializing in commercial painting and coating application with at least 10 successful jobs similar to that proposed.

C. Paint applicator shall certify the following:

1. Immediately before painting, surfaces conformed to the specified preparation; they were in the specified condition; and were clean, dry, and free of dust, rust, and mill scale to the degree required by this Specification.
2. Surface preparation and coating use, mixing, application, and curing were done in accordance with the current printed instructions and instructions of the coating manufacturer, and these Specifications.
3. The products specified were used or a listing of the names of the products used and their manufacturer was submitted and approved.
4. The products were used within the shelf-life dates, stating the shelf-life dates of each container of each product used.
5. Manufacturer’s recommended dry film thickness of coatings on the work.
6. Compatible paints were used where coatings are applied over previously applied coatings.

1.5 REGULATORY REQUIREMENTS

A. Conform to International Building Code (IBC) for flame, fuel, smoke-rating requirements for completed finishes.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store and protect products as recommended by paint manufacturer.

B. Deliver products to site in sealed and labeled containers.

C. Container labeling shall include manufacturer's name, type of paint, brand name, manufacture data, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.

D. Store paint materials at ambient temperature of 45 degrees F to 90 degrees F in well ventilated area, unless required otherwise by manufacturer's instructions. Only materials to be consumed within a 24-hour work period allowed at work site.

E. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.7 TEMPERATURE AND HUMIDITY REQUIREMENTS

A. Provide continuous ventilation and heating equipment to maintain paint products and substrate dry and at ambient temperatures between 50 and 85 degrees F. for 24 hours before, during and 48 hours after application of finishes, unless permitted otherwise by coating manufacturer's recommendations.

1. Provide temperatures by temporary scaffold enclosures and heating as necessary.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 65 percent, unless permitted otherwise by coating manufacturer's recommendations.

C. Provide lighting of 80 feet candles at work. Building lights may be used.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Companies meeting the "Quality Assurance" criteria and these specifications.

2.2 MATERIALS – AIR QUALITY

A. Conform to governing regulations including Federal and State requirements for pollution, safety and health.

2.3 PAINT MATERIALS

A. Provide compatible products in accordance with approved paint manufacturer including paint, varnish, stain, enamel, lacquer, fillers and related products for prime, intermediate and finish coats.

B. Accessory material not specifically indicated, but required, such as reducers, undercoats, primers, putty and the like, shall be of quality not less than required by applicable Specification Standards and recommended by the finish coat manufacturer in writing for compatibility and conditions of use.

C. Paints containing lead shall not be used.

D. All products “Best Line - PREMIUM GRADE” for professional trade sales recommended by paint manufacturer for the conditions of use.

E. Mixing

1. Furnish ready-mixed products except as otherwise specified.
2. Follow manufacturer’s directions for:
    a. Field-mixing of pastes and powders.
    b. Field-catalyzing components.
3. Coatings shall have good flowing application properties, capable of drying, or curing free of streaks or sags and yielding finish specified.

2.4 FINISHES

A. Refer to schedule at end of specification for surface finishes.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate time and areas of work with OWNER. Allow for building occupancy during work.

3.2 EXAMINATION

A. Verify that surface and substrate conditions are ready to receive work as specified and as recommended by the paint manufacturer.

B. Examine surfaces scheduled to be coated prior to starting work. Report any conditions that may adversely affect proper application.

C. Examine DRAWINGS, SPECIFICATIONS, and field conditions to determine extent of exposed piping, ducts, conduit, electrical controls, cabinets and equipment and allow for painting as required.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:

1. Gypsum Wallboard: 12 percent.
2. Concrete and Concrete Masonry: 12 percent and minimum 45 days at 55 to 85 degrees F. curing.
3. Concrete Floors: minimum dry condition 60 days. Conform to coating manufacturer moisture requirements.
4. Interior Located Wood: 7 percent, measured in accordance with ASTM D4442.
5. Exterior Located Wood: 12 percent, measured in accordance with ASTM D4442. Minimum 36 hours after any water pressure washing.

E. Beginning of application means acceptance of existing surfaces.

3.3 PROTECTION

A. Protect elements surrounding the work of this section from damage or disfiguration.

B. Mask and shut down heat and ventilation intakes when painting adjacent exterior surfaces.

C. Repair damage to other surfaces caused by work of this Section.

D. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

E. Protection of work when stopping for the day:

1. Erect barriers and post warning signs. Confirm that no dust generating activities will follow shutting down for the day.

3.4 ITEMS NOT TO BE PAINTED

A. The following items shall be masked and not painted unless specifically scheduled:

1. Items with factory finish paint, such as light fixtures.
2. Finished surfaces such as hardware trim, anodized aluminum, glass, stainless steel, bronze and the like.
3. Moving equipment wearing surfaces.
4. Equipment data plates, manufacturer’s permanent maintenance labels and fire door and jamb labels.

3.5 PREPARATION

A. General: Clean and prepare substrate for finish as specified and as recommended by coating manufacturer for conditions of use.

B. Coordinate with OWNER for areas which cannot use water or blast cleaning.

C. Remove or coordinate and have removed electrical plates, hardware, glazing stops, light fixture trim, and fittings prior to preparing surfaces and finishing. Replace removed items after painting.

D. Clean surfaces and correct surface defects.

1. Remove oil-grease and mildew with detergent or solvent first (do not use paint thinner, hydrocarbons, or turpentine as they leave residue).
2. Remove dirt, dust, loose material, rust-scale, oil-grease, mildew, release agents, non-adhering paint by grit blast, pressure water blast, sand papering, grinding, scraping or wire brushing.
3. Sand paper thick and sharp edges of shop and existing paint and runs to smooth featheredge.
4. Lightly abrade surfaces dull to insure adhesion.
5. Fill or sand out cracks, holes, pits and scratches, smooth to match adjacent finish.
6. Remove sanding dust prior to painting.

E. Seal stain marks, which may bleed through subsequent, finishes.

F. Existing coating to be re-painted or finished: remove loose, blistered, scratched, weathered-corroded finish, scaled or crazed finish to base material surface or feather edges smooth. Where new work joins existing work, prepare existing surfaces extending to the nearest break in the plane intersecting wall, ceiling or pilaster.

G. Impervious Surfaces: Remove mildew by scrubbing with solution of T.S.P. Rinse with clean water and allow surface to dry.

H. Aluminum Surfaces Scheduled for Coating: Remove surface contamination by solvent cleaning. Remove oxidation with acid etch followed by solvent washing. Apply primer immediately following cleaning.

I. Insulated Coverings: Remove dirt, grease, and oil from cloth jacketing.

J. Concrete and Masonry: Minimum 45 day cure, remove contamination with approved methods. Verify required acid-alkali balance is achieved.
1. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water.

2. Remove loose mortar, paint sheen, scale, salt and alkali powder, (efflorescence) and other foreign matter by 600 to 1500 psi pressure water washing or other approved methods.

K. Existing Gypsum Board Surfaces: Clean, then latex fill and smooth defects up to 2-inch holes flush with adjacent surface and match existing texture. Sand to feather edge. Spot prime defects after repair.

L. Uncoated Steel and Iron Surfaces: remove grease, scale, dirt and rust per SPC SP1Solvent Cleaning. Clean per SPC SP3 power tool cleaning, or SP2 hand cleaning, or SP7 brush-off blast cleaning.

M. Shop Primed Steel Surfaces: Solvent clean per SPC SP1 followed by sanding, scraping and wire brushing per SPC SP2 hand cleaning to remove loose, scratched or weathered-corroded shop finish primer weld burns and rust. Feather edges to make inconspicuous. After cleaning and prior to painting remove dust and similar containment's by air blast or vacuum.

N. Exterior Wood: Remove dust, grit, and foreign matter. Seal knots, pitch streaks and sappy sections

O. Doors Scheduled for Painting: Paint top and bottom edges with paint after door fitting.

3.6 APPLICATION

A. Apply coatings to all visible exposed surfaces scheduled in accordance with approved coating manufacturer's instructions and approved submittals for the conditions of use.

B. Do not apply finishes to surfaces that are not clean, dull, and dry.

C. Apply each coat to uniform finish.

D. Sand or abrade lightly and clean between coats to achieve adhesion if recommended by coating manufacturer.

E. Apply materials so that the following results are obtained.

1. Smooth uniform appearance, underlying paint edges feathered, free of brush marks, uneven orange peel, sags, runs or foreign matter.
2. Complete coverage without skips or streaks and without heavy build-up in details.
3. Close match with approved color.
4. Sharp edges at adjoining materials or at color changes.
5. Work stain finishes thoroughly into wood by brushing or rolling.

F. Inspection of Coats: Do not apply additional coats until each completed coat has been inspected by the CONTRACTING OFFICER.

1. Only inspected and approved coats of paint shall be considered in determining number of coats applied.
2. Refinish entire surface if coat is not acceptable.

3.7 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Paint shop primed items.

B. Clean, prime and paint exposed mechanical and electrical work including: pipes, pipe insulation, conduit, boxes, ducts, hangers, brackets, collars and supports.

C. Protect and retain legibility of data plates and identification markings on mechanical and electrical equipment by masking.

D. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

3.8 CLEANING

A. As Work proceeds, promptly remove excess paint products where spilled, splashed or spattered.

B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials and debris.

C. Remove waste, cloths, and material, which may constitute fire or V.O.C. hazard daily from site.

D. Leave surfaces not required to be finished under this section undamaged and clean and free of paint products from work of this Section.

3.9 COATING SCHEDULE

A. General:

1. For the purposes of this schedule each coat shall be at least dry to the touch before proceeding with the following coat.

2. Coating materials shall be recommended by manufacturer for condition of use and compatible with undercoats.

3. Minimum number of coats is scheduled. Apply additional finish coats as necessary to provide uniform appearing coverage.

4. Sherwin Williams products are referenced. Other manufacturers having similar specifications meeting Quality Assurance specifications may be used.

B. Exterior Coating Schedule:

1. Wood:

a. One coat topcoat compatible exterior latex primer sealer; Sherwin Williams “ProBlock”.

b. Two coats, exterior latex enamel finish, satin sheen Sherwin Williams, “A-100”.

2. Concrete, Concrete Masonry:

a. Two coats exterior latex enamel satin sheen, Sherwin Williams “A-100”.

3. Steel Previously Painted:

a. Spot Prime Compatible rust inhibiting acrylic emulsion prime Sherwin Williams “Pro-Cry” Universal Primer”

b. Two coats acrylic corrosion resistant water based alkyd urethane enamel, semi-gloss sheen Sherwin Williams “Pro Industrial”.

C. Interior Coating Schedule

1. Concrete, and Masonry:

    a. 1 coat alkali resistant acrylic latex masonry primer filler: Sherwin Williams “Loxon” primer.

    b. 2 coats water based alkyd urethane enamel, semi-gloss enamel, eggshell sheen: Sherwin Williams “Pro Industrial”.

2. Gypsum Board:

    a. Spot prime any stains with stain blocking primer sealer over stained area; Sherwin Williams “Quick Dry” B51 W08670, sealer primer surface, top coat compatible.

    b. 2 coats water based enamel, low sheen. Sherwin Williams “Pro Industrial”.

3. Concrete Floors Painted:

    a. 2 coats water based two-component floor coating: recommended for commercial and industrial concrete floors.

    b. Self-priming satin sheen: Sherwin Williams “Armorseal 8100”.

    c. Abrasion resistance: 50 mg max loss at “1000 cycles” per ASTM D4060.

    d. Slip resistance: 0.60 min static wet per ASTM C1028.

    e. Water Vapor perms: 5 grains hour/sf.

3.10 COLOR SCHEDULE

A. Match adjacent surface color for the following:

1. Access doors, registers, radiation unit covers, exposed piping, electrical conduit, and mechanical/electrical panels.

2. Exterior wall and roof mounted pipes, ducts, conduits, flues and flashing.

END OF SECTION

SECTION 22 05 29 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Sleeves.
6. Formed steel channel.

B. Related Sections:

1. Division 03- Concrete Forming and Accessories: Execution requirements for placement of inserts and sleeves in concrete forms specified by this section.
2. Division 03 - Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
3. Section 22 10 00 - Plumbing Piping: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.9 - Building Services Piping.

B. 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 F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

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

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. 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 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

1.3 SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

B. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

C. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

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 of experience.

B. Installer: Company specializing in performing Work of this section with minimum three years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be in accordance with MASS 2015.

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 damage, by storing in original packaging.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Product Requirements: Environmental conditions affecting products on site.

B. Provide ventilation in areas to receive solvent cured materials.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

B. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

C. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer’s written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Michigan Hanger Company.
2. B-Line Systems, Inc.
3. Substitutions: 2015 MASS - Product Requirements.

B. Plumbing Piping - DWV:

1. Conform to MSS SP58.
2. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
3. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
4. Vertical Support: Steel riser clamp.

C. Plumbing Piping - Water:

1. Conform to MSS SP58.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
5. Vertical Support: Steel riser clamp.
6. Copper Pipe Support: Copper-plated, Carbon-steel ring.

2.2 ACCESSORIES

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

2.3 INSERTS

A. Inserts: Malleable iron case of galvanized 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.

2.4 FLASHING

A. Metal Flashing: 26-gauge thick galvanized steel.

B. Metal Counterflashing: 22-gauge thick galvanized steel.

C. Flexible Flashing: 47 mil thick sheet butyl compatible with roofing.

D. Caps: Steel, 22-gauge minimum; 16 gauge at fire resistant elements.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gauge thick galvanized steel.

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

2.6 FORMED STEEL CHANNEL

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Verify openings are ready to receive sleeves.

3.2 PREPARATION

A. Obtain permission from Architect/Engineer before using powder-actuated anchors.

B. Do not drill or cut structural members.

3.3 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 4 inches and larger.

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 above slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME 31.9, ASTM F708, and 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. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

H. Support riser piping independently of connected horizontal piping.

I. Design hangers for pipe movement without disengagement of supported pipe.

J. Prime coat exposed steel hangers and supports.

K. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Division 03.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - FLASHING

A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.

3.7 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

E. Install chrome plated steel escutcheons at finished surfaces.

3.8 FIELD QUALITY CONTROL

A. Quality Requirements: Requirements for inspecting, testing shall be in accordance with MASS 2015.

3.9 CLEANING

A. Execution and Closeout Requirements: Requirements for cleaning shall be in accordance with MASS 2015.

3.10 PROTECTION OF FINISHED WORK

A. Execution and Closeout Requirements: Requirements for protecting finished Work shall be in accordance with MASS 2015.

B. Protect adjacent surfaces from damage by material installation.

3.11 SCHEDULES

PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches

Cast Iron (All Sizes)	5	5/8
Cast Iron (All Sizes) with 10 foot length of pipe	10	5/8
Copper Tube, 1-1/4 inches and smaller	6	1/2
Copper Tube, 1-1/2 inches and larger	10	1/2

PIPE HANGER AND SUPPORT SPACING		
PIPE MATERIAL	MAXIMUM HORIZONTAL HANGER SPACING (Feet)	MAXIMUM VERTICAL SUPPORT SPACING (Feet)
Cast Iron (pipe lengths 4’ or less)	Every other joint	15
Cast Iron (pipe lengths over 4’)	Every joint	15
Copper (1-1/2” or less)	6	10
Copper (over 1-1/2”)	10	10

PIPE HANGER ROD DIAMETER	
PIPE AND TUBE SIZE (Inches)	ROD SIZE (Inches)
1/2" – 4”	3/8”

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 05 29 - Hangers and Supports for Plumbing Piping and Equipment.
   2. Section 22 05 53 - Identification for Plumbing Piping and Equipment

1.2 REFERENCES

A. ASTM International:
   1. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
   2. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
   3. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
   4. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
   5. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
   6. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   7. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

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. Product storage and handling requirements shall be in accordance with MASS 2015.

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. 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. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

B. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

C. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer's written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Certain-Teed.

B. Johns Manville.

C. Knauf.

D. Owens-Corning.

E. Substitutions: 2015 MASS - Product Requirements.

2.2 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.

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.

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. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Administrative Requirements: Coordination and project conditions in accordance with MASS 2015.

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 jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips.
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. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

E. Heat Traced Piping Interior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer.

3.3 SCHEDULES

A. Drainage Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Storm Piping (horizontal above ground within building)	P-1	All sizes	1.0

END OF SECTION

SECTION 22 10 00 – PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and pipe fittings
2. Unions and flanges
3. Pipe identification

1.2 REFERENCE

A. American Society of Mechanical Engineers:

1. ASME A13.1 – Scheme for the Identification of Piping Systems.
2. ASME B16.3 - Malleable Iron Threaded Fittings.

B. Cast Iron Soil Pipe Institute

1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

1.3 SUBMITTALS

A. Product Data:

1. Pipe Hangers and Supports: Submit manufacturers catalog data including load carrying capacity.
2. Plumbing supply specialties: Submit manufacturers catalog information with sizes, capacities, rough-in requirements, service sizes, and finishes.

B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

C. Submittals shall be in conformance to MASS Section 10.05 Article 5.6 and the requirements of this Section.

1.4 CLOSEOUT SUBMITTALS

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

B. Submittals shall be in conformance to MASS Section 10.05 Article 5.6 and the requirements of this Section.

1.5 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. Storm Water Piping, Above Grade:
   1. Pipe: Cast Iron, CISPI 301, hubless, service weight
   2. Fittings: Cast iron, CISPI 301
   3. Joints: CISPI 310, neoprene gaskets and stainless-steel clamp-and-shield assemblies

2.2 DOWNSPOUT NOZZLE

A. Bronze body and round wall flange with mounting holes to cover rough opening and serve as anchor. Opening protection to include welded bird screen notched for heat trace.

2.3 UNIONS AND FLANGES

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping.

2.4 PIPE AND VALVE IDENTIFICATION

A. Manufacturers:

   1. Craftmark Pipe Markers
   2. Marking Services Inc.
   3. Brimar Industrustries, Inc.
   4. Seton Identification Products.

5. Substitutions: Division 01

B. Pipe Markers:
   1. Color and lettering to conform to ASME A13.1
   2. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

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.

3.2 INSTALLATION - PIPING SYSTEMS

A. Route piping parallel to building structure and maintain gradient.

B. Install piping to maintain headroom. Group piping to conserve space. Group piping whenever practical at common elevations.

C. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.3 INSTALLATION - PLUMBING DRAINAGE PIPING

A. Install bell and spigot pipe with bell end upstream.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Install with clearance at cleanout for rodding of drainage system.

C. Install floor cleanouts at elevation to accommodate finished floor.

D. Install piping penetrating roofed areas to maintain integrity of roof assembly.

E. Establish invert elevations, slopes for drainage to 1/4 inch per foot minimum. Maintain gradients.

3.4 SCHEDULES

PIPE HANGER AND SUPPORT SPACING		
PIPE MATERIAL	MAXIMUM HORIZONTAL HANGER SPACING (Feet)	MAXIMUM VERTICAL SUPPORT SPACING (Feet)
Cast Iron (pipe lengths 4’ or less)	Every other joint	15
Cast Iron (pipe lengths over 4’)	Every joint	15

PIPE HANGER ROD DIAMETER	
PIPE AND TUBE SIZE (Inches)	ROD SIZE (Inches)
1/2" – 4”	3/8”

3.5 INSTALLATION – PIPING AND VALVE IDENTIFICATION

A. Install identification devices after completion of coverings and painting.

B. Identify piping with plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 23 05 00 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SCOPE

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

1.2 WORK INCLUDED

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

B. Division 01 of the specifications is to be specifically included as well as all related drawings.

1.3 RELATED WORK

A. Related Work Specified Elsewhere:

1. Electrical Specifications: Division 26
2. Motors and Connections: Division 26
3. Starters and Disconnects: Division 26

B. Unless otherwise indicated on the electrical drawings or the electrical schedules, provide all mechanical equipment motors, motor starters, thermal overload switches, control relays, time clocks, thermostats, motor operated valves, float controls, damper motors, electrical components, wiring and any other miscellaneous Division 23 controls. Disconnect switches are included in the electrical work, unless specifically called out on mechanical plans.

C. Carefully coordinate all work with the electrical work shown and specified elsewhere.

1.4 REFERENCED CODES - LATEST ADOPTED EDITION

A. NFPA 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
H.	IECC	International Energy Conservation Code

1.5 REFERENCED STANDARDS/TESTING AGENCIES

A.	UL	Underwriters Laboratories
B.	AMCA	Air Movement and Control Association
C.	ANSI	American National Standards Institute
D.	ASME	American Society of Mechanical Engineers
E.	ASTM	American Society for Testing and Materials
F.	NEMA	National Electric Manufacturers Association
G.	AGA	American Gas Association
H.	ASHRAE	American Society of Heating and Refrigeration Engineers
I.	SMACNA	Sheet Metal & Air Conditioning Contractors National Association

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 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.

C. Catalog sheets shall be complete and the item or model to be used shall be clearly marked, and identified as to which item in the specifications or on the drawings is being submitted and with drawing fixture number where applicable.

D. *Only submit* on items specifically required by each specification section. If a submittal has not been requested, it will not be reviewed.

E. Submit shop drawings indicating seismic restraint to the Municipality Plan Review for approval prior to installation of equipment that requires restraint for wind and seismic loads by the IBC. The submittal shall be prepared by an engineer employed by the manufacturer of the seismic restraint products used for the project. The seismic design shall be based upon the seismic hazard level and shall take into account the maximum point loading possible with the structural design shown on the plan set for this project.

1.7 QUALITY ASSURANCE

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

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. Show exact dimensions of buried piping off of columns or exterior walls.

B. Show the location of all valves and their appropriate tag identification.

C. Maintain record documents at job site in a clean, dry and legible condition. Keep record documents available for inspection by the Project Manager.

D. 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. See General Conditions and the General Requirements in Division 01 for substitution request procedures.

B. In accordance with the General Conditions and the General Requirements in Division 01, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better-quality including efficiency performance, size, and weight, and must be compatible with existing equipment. The 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 AWWU Project Manager 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 AWWU Project Manager 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.

G. "Accessible" is defined as clear space for a 6 foot tall, 200 pound person with a 50 pound toolbox to be able to operate, maintain, repair, or replace equipment specified.

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. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

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 WARRANTY

A. Unless a longer guarantee is hereinafter called for, all work, materials and equipment items shall be guaranteed for a period of two (2) years after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the AWWU Project Manager, shall be repaired and/or replaced to the complete satisfaction of the AWWU Project Manager. Warranty 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 prints, showing all changes from the original plans made during installation of the work.
2. Contractor's two (2) years warranty.
3. All manufacturers' guarantees.
4. Test and balance reports.
5. Operation and maintenance manuals.

1.20 INSEPCTION OF SITE - REMODEL PROJECTS

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

1.21 RELOCATION OF EXISTING INSTALLATIONS

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

1.22 SALVAGE MATERIALS

A. The Contractor shall remove existing equipment and other items associated with the mechanical systems where no longer required for the project. Where such items are exposed to view or uncovered by any cutting or removal of general construction and has no continuing function (as determined by the Architect/Engineer), they shall be removed.

B. All items or materials removed from the project shall be made available for the Owner's inspection. The Owner retains the option to claim any item or material. The Contractor shall deliver any claimed item or material in good condition to the place designated by the Owner. All items not claimed become the property of the Contractor and shall be removed from the site by the Contractor.

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.

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. All materials utilized in domestic water system shall be certified by an ANSI accredited organization to conform to ANSI/NSF Standard 61.”

D. Where materials or equipment provided by this Contractor are found to contain restricted materials, such items shall be removed and replaced with non-restricted materials items. Entire cost of restricted materials removal and disposal and cost of installing new items shall be the responsibility of the Contractor for those restricted materials containing items installed by the Contractor.

2.3 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.

2.4 ELECTRICAL MOTORS

A. Motors: Furnish electric motors designed for the specific application and duty applied, and to deliver rated horsepower without exceeding temperature ratings when operated on power systems with a combined variation in voltage and frequency not more than + 10% of rated voltage. Motors for pumps and fans shall be selected to be non-overloading.

B. Verify from the drawings and specifications the available electrical supply characteristics and furnish equipment that will perform satisfactorily under the conditions shown and specified.

C. Size motors for 1.15 service factor and not to exceed 40º C temperature rise above ambient.

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.

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. Obtain and pay for all inspection fees, connection charges and permits as a part of the Contract.

C. Compliance with codes and ordinances shall be at the Contractor's expense.

3.3 MEASUREMENTS

A. Verify all measurements on the job site.

B. Locate all equipment and fixtures on the centers of walls, openings, spaces, etc., unless specified otherwise.

C. Check all piping, ducts, etc. to clear openings.

D. Rough-in dimensions shall be per manufacturer's recommendations and in compliance with ADA and ANSI 117.1 Guidelines.

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.

C. When required by individual specifications sections provide additional training on plumbing systems and equipment.

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 submitted by specification section complete and all at one time; partial operations and maintenance manual submittals will not be considered. The Operation and maintenance manuals shall be provided for review in electronic PDF Format. The data in the electronic file shall be arranged and indexed under basic categories. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications. Final 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. A copy of valve schedule and reduced scale drawings showing valve locations.
6. Written summary of instructions to Owner.
7. Test and balance final report.
8. All manufacturers’ warranties and guarantees.

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 SYSTEM ADJUSTING

A. In accordance with Section 23 05 93, Testing, Adjusting and Balancing.

B. Each part of each system shall be adjusted and readjusted as necessary to ensure proper functioning of all controls, proper air distribution, elimination of drafts, and noise and vibration.

C. Balance air and water systems for volume quantities shown and as required ensuring even temperature and the elimination of drafts. Balancing shall be done by a qualified firm acceptable to the Engineer. Provide balancing log to the Engineer before substantial inspection.

3.7 CUTTING, FITTING, PATCHING AND FINISH

A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where it is necessary to disturb such work to permit installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.

B. Avoid cutting, insofar as possible, by setting sleeves, frames, etc. and by requesting openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for piping.

C. Cut all holes neatly and as small as possible to admit work. Include cutting where sleeves or openings have been omitted. Perform cutting in a manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.8 PAINTING

A. Perform all of the following painting in accordance with provisions of Division 9 with colors as selected by the Architect. Provide the following items as a part of mechanical work:

1. Factory applied prime and finish coats on mechanical equipment.
2. Factory applied prime coat on access doors.
3. Pipe identification where specified.

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

3.9 INSTALLATION OF EQUIPMENT

A. Unless otherwise indicated, mount all equipment and install in accordance with manufacturer's recommendations and approved submittals.

B. Maintain manufacturer’s 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.

E. Openings: Arrange for necessary openings in buildings to allow for admittance and reasonable maintenance or replacement of all apparatus furnished under this Contract.

F. Access Doors: Provide as necessary for reasonable maintenance of all equipment valves, water hammer arrestors, trap primers, and controls, etc.

END OF SECTION

SECTION 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Equipment bases and supports.
4. Flashing and sealing equipment and pipe stacks
5. Sleeves and seals

B. Products furnished but installed under other sections.

1. Furnish hangers and supports for placement of formwork.
2. Placement of equipment roof support curbs.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common work Results for HVAC: Execution requirements for placement of hangers and supports specified by this section.

B. Section 23 05 48 - Vibration and Seismic controls for HVAC Piping, Ductwork, and Equipment

C. Section 23 05 53 – Identification for HVAC Piping, Ductwork, and equipment.

D. Section 23 07 00 - HVAC Insulation.

E. Section 23 11 23 – Natural Gas Piping.

F. Section 23 31 00 – HVAC Ducts and Casing

1.3 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.2 – Fuel Gas Piping
3. ASME B31.5 - Refrigeration Piping.
4. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

C. International Code Council:

1. International Fuel Gas Code (IFGC)
2. International Mechanical Code (IMC)

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.4 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of ductwork and hydronic piping.

1.5 SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

B. Product Data: Submit manufacturers catalog data including load capacity.

C. Manufacturer's Installation Instructions: Submit special procedures and assembly of components.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be in accordance with MASS 2015.

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

1.7 WARRANTY

A. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

B. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

C. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer's written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Michigan Hanger Company.
2. B-Line Systems, Inc.
3. Substitutions: 2015 MASS - Product Requirements.

2.2 ACCESSORIES

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

2.3 ANCHOR BOLTS

A. Anchor (Expansion) Bolts: Shall be carbon steel to ASTM A 307; nut shall conform to ASTM A194; shall be drilled-in type. Design values for shear and tension shall be not more than 80 percent of the allowable load.

2.4 INSERTS

A. Inserts: Malleable iron case of galvanized 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.

2.5 FLASHING

A. Metal Flashing: 26 gauge thick galvanized steel.

B. Metal Counterflashing: 22 gauge thick galvanized steel.

C. Flexible Flashing: 47 mil thick sheet butyl compatible with roofing.

D. Caps: Steel, 22 gage minimum; 16 gauge at fire resistant elements.

2.6 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel for 4” diameter and larger. 22 gauge up to 3inch diameter.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge thick galvanized steel for 4 inch diameter and larger, 22 gauge up to 3 inch diameter.

C. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

A. Strut Type Pipe Hanging System: Unistrut P-1000 series; framing members shall be No. 12 gauge formed steel channels, 1-5/8 inch square, conforming to ASTM A 570 GR33, one side of channel shall have a continuous slot with inturned lips; framing nut with grooves and spring 1/2 inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A 307; fittings conforming to ASTM A 575; all parts enamel painted or electrogalvanized.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Administrative requirements in accordance with MASS 2015: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

3.2 PREPARATION

A. Do not drill or cut structural members.

3.3 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 4 inches and larger.

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 above slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME 31.9, ASTM F708, and MSS SP 89.

B. Support horizontal piping in accordance with the latest adopted edition of the IMC and IFGC.

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. Support vertical piping at every floor.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 23 07 00.

L. Provide anchors in accordance with Specification Section 23 05 48.

M. Provide seismic restraint in accordance with Specification Section 23 05 48.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide and or extend existing housekeeping pads of concrete type where shown on plans. Where housekeeping pads are preexisting, level pads before installing new equipment. 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.

C. Anchor (Expansion) Bolts: Install anchor bolts for all HVAC, plumbing, gas piping and equipment as required. Tightly fit and clamp base-supported equipment

anchor bolts at all equipment support points. Provide locknuts where piping and equipment is hung. Install anchor (expansion) bolts in holes drilled in concrete where necessary to hang piping or equipment, or to anchor stationary equipment from existing concrete slabs.

3.6 INSTALLATION - FLASHING

A. Provide flexible flashing and metal counter flashing where piping penetrates weather resistant or waterproofed walls, floors, and roofs. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash and seal.

B. Provide curbs for mechanical roof installations as indicated on the plans.

C. Adjust storm collars tight to pipe with bolts; caulk around top edge.

3.7 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Where piping or duct penetrates floor, ceiling, or wall, install sleeve, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal. Use fire rated caulking where area or occupancy separation walls are penetrated. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

3.8 PROTECTION OF FINISHED WORK

A. Execution and Closeout Requirements shall be in accordance with MASS 2015

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 23 05 48 – VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vibration isolators.
2. Seismic bracing.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common work Results for HVAC

B. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

C. Section 23 31 00 - HVAC Ducts and Casings

D. Section 23 33 00 - Air Duct Accessories

1.3 REFERENCES

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

1. ASHRAE Handbook - HVAC Applications.

B. Sheet Metal and Air Conditioning Contractors' National Association:

1. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
2. SMACNA - Seismic Restraint Manual

1.4 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of ductwork.

1.5 SUBMITTALS

A. Submit Shop Drawings in accordance with MASS Section 10.05 Article 5.5.

1. Indicate for shop fabricated assemblies including seismic bracing locations.

B. Submit Product Data in accordance with MASS Section 10.05 Article 5.6: Submit data for shop fabricated assemblies and hardware used.

1. Product Data: Submit data including load capacity on each type of vibration isolator to be used and/or indicate if provided by equipment manufacturer.
2. Manufacturer's Installation Instructions: Submit special procedures and assembly of components.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be in accordance with MASS 2015.

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

1.7 WARRANTY

A. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

B. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

C. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer's written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Provide vibration isolation devices on motor-driven equipment over 0.5 hp, plus connected piping and ductwork.

B. Minimum Static Deflection of Isolators:

1. Ground Floor - Under 20 hp.
   a. Over 1,500 rpm: 0.1 inch.

2.2 VIBRATION ISOLATORS

A. Manufacturers:

1. Michigan Hanger Company.
2. B-Line Systems, Inc.
3. Substitutions: 2015 MASS - Product Requirements.

B. Open Spring Isolators:

1. Spring Isolators:
   a. Furnish hot-dip galvanized housings and neoprene-coated springs.
   b. Code: Color-code springs based on load carrying capacity.

2. Springs:
   a. Minimum Horizontal Stiffness: 75 percent of vertical stiffness.
   b. Working Deflection: Between 30 and 60 percent of maximum deflection.

3. Spring Mounts: Furnish leveling devices, minimum 0.25-inch thick neoprene sound pads, and zinc chromate-plated hardware.

C. Restrained Spring Isolators:

1. Spring Isolators:
   a. Furnish hot-dip galvanized housings and neoprene-coated springs.
   b. Code: Color-code springs based on load carrying capacity.

2. Springs:
   a. Minimum Horizontal Stiffness: 75 percent of vertical stiffness.
   b. Working Deflection: Between 30 and 60 percent of maximum deflection.

3. Spring Mounts: Furnish leveling devices, minimum 0.25-inch thick neoprene sound pads, and zinc chromate-plated hardware.

4. Restraints: Furnish mounting frame and limit stops.

D. Closed Spring Isolators:

1. Spring Isolators:
   a. Furnish hot-dip galvanized housings and neoprene-coated springs.
   b. Code: Color-code springs based on load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated by neoprene rubber stabilizers.

3. Springs:
   a. Minimum Horizontal Stiffness: 75 percent of vertical stiffness.
   b. Working Deflection: Between 30 and 60 percent of maximum deflection.

4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators and neoprene side stabilizers with minimum clearance of 0.25 inch.

E. Restrained Closed Spring Isolators:

1. Spring Isolators:
   a. Exterior and Humid Areas: Furnish hot-dip galvanized housings and neoprene-coated springs.
   b. Code: Color-code springs based on load carrying capacity.

2. Type: Closed spring mount with top and bottom housing separated by neoprene rubber stabilizers.

3. Springs:
   a. Minimum Horizontal Stiffness: 75 percent of vertical stiffness.
   b. Working Deflection: Between 30 and 60 percent of maximum deflection.

4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators and neoprene side stabilizers with minimum clearance of 0.25 inch and limit stops.

F. Spring Hangers:

1. Spring Isolators:
   a. Exterior and Humid Areas: Furnish hot-dip galvanized housings and neoprene-coated springs.
   b. Code: Color-code springs based on load carrying capacity.

2. Springs:
   a. Minimum Horizontal Stiffness: 75 percent of vertical stiffness.
   b. Working Deflection: Between 30 and 60 percent of maximum deflection.

3. Housings: Incorporate rubber hanger with threaded insert.

4. Misalignment: Capable of 20-degree hanger rod misalignment.

G. Seismic Snubbers:

1. Description: Non-directional and double-acting unit consisting of interlocking steel members restrained by neoprene elements.

2. Neoprene Elements:
   a. Replaceable.
   b. Minimum Thickness: 0.75 inch.

3. Capacity: Four times assigned load to mount groupings at 0.4-inch deflection.

4. Attachment Points and Fasteners: Capable of withstanding three times rated load capacity of seismic snubber.

2.3 SEISMIC BRACING COMPONENTS

A. Manufacturers:
   1. Michigan Hanger Company.
   2. B-Line Systems, Inc.
   3. Substitutions: 2015 MASS - Product Requirements.

B. Seismic Cable Restraints: Adjustable Seismic cable sway bracing restraints shall consist of 7x19 galvanized steel aircraft cable sized to resist seismic loads. Cable restraint system shall be completely preassembled to eliminate onsite assembly of restraint components and must allow quick and easy adjustment on the length of the cable after the installation to remove excessive sag on the cable. Cable end connections shall use heavy brackets, thimbles, and wire rope clips or compression sleeves.

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install isolation for motor-driven equipment per manufacturer’s instructions.

B. Bases:

   1. Steel: Provide 1 inch of clearance between housekeeping pad and base.

C. Make equipment level.

D. Install spring hangers without binding.

E. Isolators:

   1. Closed Spring Isolators: Adjust such that side stabilizers are clear under normal operating conditions.
   2. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height; when full load is applied, adjust isolators to load to allow shim removal.

F. Snubbers:

1. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers.
2. Provide each inertia base with minimum of four seismic snubbers located close to isolators.

3. Other Snubbers: Provide clearance between 0.15 and 0.25 inch (4 and 7 mm).

G. Support piping connections to isolated equipment resiliently for scheduled distance.

H. Seismic bracing

END OF SECTION

SECTION 23 05 53 – IDENTIFICATION FOR HVAC PIPING, DUCTWORK, AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes identification of HVAC piping, ductwork and equipment installed under Division 23.

1. Nameplates.
2. Tags.
3. Stencils.

1.2 RELATED DOCUMENTS

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and MASS 2015 Specifications Sections, apply to this section.

1.3 REFERENCES

A. American Society of Mechanical Engineers:

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

1.4 SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

B. Product Data: Submit manufacturers catalog literature for each product required.

1.5 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements shall be in accordance with MASS 2015.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Craftmark Pipe Markers.

B. Brimar Industries, Inc.

C. Seton Identification Products.

D. Substitutions: 2015 MASS - Product Requirements.

2.2 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color. Plate size minimum ¾" x 2-½".

B. Color, unless otherwise specified, to confirm with ASME A13.1.

2.3 TAGS

A. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches square.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-½" inches square with smooth finished edges.

2.4 STENCILS

A. Stencils: With clean cut symbols and letters of following size:

Outside Diameter of Insulation, Pipe or Duct	Length of Color Field	Size of Letters
¾" - 1-¼"	8"	½"
1-½" - 2"	8"	¾"
2-½" - 6"	12"	1-¼"
8" - 10"	24"	2-½"
Over 10"	32"	3-½"
Ductwork and Equipment	------	2-½"

B. Stencil Paint: Semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

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 instructions for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting in accordance with manufacturer's recommendations for a neat and legible appearance.

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 HVAC fans and makeup air units with plastic nameplates.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Locations: Nameplates shall be located so as to be readily visible to maintenance personnel. Motor nameplates shall be readily visible on accessible, three phase motors, otherwise a duplicate motor nameplate shall be permanently affixed to the driven machinery in a visible locations.

I. Makeup Air Unit Tags: MAU tags shall Indicate MAU number.

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 air systems.

B. Related Sections:

1. Section 23 09 23 - Direct-Digital Control System for HVAC: Requirements for coordination between DDC system and testing, adjusting, and balancing work.

1.2 SCOPE

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

B. All new air systems in the entire facility shall be tested and balanced at the end of construction to ensure a fully operational building for the Owner.

1.3 REFERENCES

A. SMACNA HVAC Systems – Testing, Adjusting, and Balancing.

B. AMCA Publication 203, Field Performance Measurements.

C. American Air Balancing Council (AABC) Recommended Procedures.

D. ASHRAE Standard 111.

E. National Environmental Balancing Bureau (NEBB) Recommended Procedures.

1.4 SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

B. Submit balancing agency qualifications and sample balancing forms.

C. Provide a list of equipment to be used and date of last calibration.

D. Submit preliminary balancing report a minimum of one week prior to substantial completion.

E. Submit final balancing report with written response to comments.

1.5 QUALIFICATIONS OF THE BALANCING FIRM OR COMPANY

A. Subcontractor minimum qualifications include:

1. Maintain a complete service organization that has operated within Alaska for at least three years prior to bid date of this project.
2. Demonstrate satisfactory completion of five projects of similar scope in the State of Alaska during the past five years.

1.6 TIMING OF WORK

A. Do not begin balancing and testing until the systems, including controls, are completed and in full working order.

B. Schedule the testing and balancing work in cooperation with other trades.

C. Complete the testing and balancing at least one week before the date of substantial completion.

1.7 CONTRACTOR RESPONSIBILITY TO BALANCING AGENCY

A. Award the test and balance contract to an approved firm or company upon receipt of contract to all the Balance and Testing Agency to schedule this work in cooperation with other trades involved and comply with completion date.

B. Put all heating, ventilating and air conditioning systems, equipment, and controls into full operation for the Balancing Agency and continue the operation of same during each working day of testing and balancing.

C. Provide scaffolding, ladders, and access to each system for proper testing and balancing.

D. Make any changes in pulleys, belts, and dampers as required for correct balance as recommended by the Balance and Testing Agency at no additional cost to the Owner.

1.8 REPORT

A. Certified Reports: Submit testing, adjusting, and balancing reports bearing the signature of the Test and Balance Agency Representative. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the system. Follow the procedures and format specified below:

1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be handwritten, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports.
2. Final Reports: Upon verification and approval of the draft report; prepare final reports, typewritten, organized and formatted as specified below.
3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Divide the contents of the report into the below listed divisions, separated by flysheets:

    a. General Information and Summary.
    b. Air Systems.
    c. Temperature Control Systems.
    d. Special Systems.
    e. Sound and Vibration Systems.
    f. System Deficiency Reports and Corrective Actions.

4. Report Contents: Provide the following minimum information, forms, and data:

    a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency; contractor; owner, architect, engineer, and project. Include addresses, contact names, and telephone numbers. Also include a certification sheet containing the name, address, telephone number and signature of the Certified Test and Balance Personnel. Include in this division a listing of the instrumentation used for the procedures along with the proof of calibration.
    b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
    c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

PART 2 - PRODUCTS

2.1 INSTRUMENTS

A. Maintain all instruments accurately calibrated and in good working order. Use instruments with the following minimum performance characteristics:

1. Air Velocity Instruments: Direct reading in feet per minute, 2% accuracy.
2. Static Pressure Instruments: Direct reading in inches water gauge, 2% accuracy.
3. RPM Instruments: Direct reading in revolutions per minute, .5% accuracy; or revolution counter accurate within 2 counts per 1,000.
4. Pressure Readout: Direct reading in feet of water or PSI, .5% accuracy.
5. Temperature Instruments - Direct reading in degrees F, +.5% accuracy.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Access doors are closed, and duct end caps are in place.
8. Air outlets are installed and connected.
9. Duct system leakage is minimized.

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. Air Handling Systems: Adjust to within plus or minus 10 percent of design.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space.

3.4 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.

B. Permanently mark settings of dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

D. Report defects and deficiencies noted during performance of services, preventing system balance.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.

B. Make air flow rate measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain:

1. Space temperatures within 2 degrees F.
2. Minimal objectionable drafts.

E. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

F. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

G. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

H. Adjust outside air automatic dampers for design conditions.

I. Measure temperature conditions across outside air dampers to check leakage.

J. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.10 inches differential static pressure between spaces per sequence of operations.

3.6 SCHEDULES

A. Partial list of Equipment Requiring Testing, Adjusting, and Balancing:

1. Make-Up Air Units.
2. Fans.
3. Air Filters.
4. Air Inlets and Outlets.

B. Report Forms

1. Title Page:

a. Name of Testing, Adjusting, and Balancing Agency
b. Address of Testing, Adjusting, and Balancing Agency
c. Telephone number of Testing, Adjusting, and Balancing Agency
d. Project name
e. Project location
f. Project Architect
g. Project Engineer
h. Project Contractor
i. Report date

2. Summary Comments:

a. Design versus final performance
b. Notable characteristics of system
c. Description of systems operation sequence
d. Summary of outdoor and exhaust flows to indicate building pressurization.
e. Nomenclature used throughout report.
f. Test conditions

3. Instrument List:

a. Instrument
b. Manufacturer
c. Model number
d. Serial number
e. Range
f. Calibration date

4. Electric Motors:

    a. Manufacturer
    b. Model/Frame
    c. HP/BHP and kW
    d. Phase, voltage, amperage; nameplate, actual, no load
    e. RPM
    f. Service factor
    g. Starter size, rating, heater elements
    h. Sheave Make/Size/Bore

5. Air Moving Equipment:

    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Arrangement/Class/Discharge
    f. Air flow, specified and actual.
    g. Outside air flow, specified and actual.
    h. Total static pressure (total external), specified and actual
    i. Inlet pressure
    j. Discharge pressure
    k. Sheave Make/Size/Bore
    l. Number of Belts/Make/Size
    m. Fan RPM

6. Exhaust Fan Data:

    a. Location
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Air flow, specified and actual.
    f. Total static pressure (total external), specified and actual
    g. Inlet pressure
    h. Discharge pressure
    i. Sheave Make/Size/Bore
    j. Number of Belts/Make/Size
    k. Fan RPM

END OF SECTION

SECTION 23 07 00 – HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ductwork Insulation, jackets and accessories.

1.2 RELATED WORK

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

B. Section 23 05 29 - Hangers and Supports for HVAC Piping, Ductwork and Equipment.

C. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment.

1.3 REFERENCES

A. ASTM International:
   1. ASTM B209 - Aluminum and Aluminum-alloy Sheet and Plate.
   2. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
   3. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   4. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
   5. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
   6. ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
   7. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
   8. ASTM C578 - Preformed, Block Type Cellular Polystyrene Thermal Insulation.
   9. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
   10. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
   11. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   12. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. National Fire Protection Association:

   1. NFPA 255 – Standard Method of Test of Surface Burning Characteristics

C. Underwriters Laboratories Inc:

1. UL 723 – Test for Surface Burning Characteristic of Building Materials

1.4 SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

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.

1.5 QUALITY ASSURANCE

A. Test insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84 and UL 723.

1.6 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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be in accordance with MASS 2015.

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.

1.8 ENVIRONMENTAL REQUIREMENTS

A. 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.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

B. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

C. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

D. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer's written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Certain-Teed.

B. Johns Manville.

C. Knauf.

D. Owens-Corning.

E. Substitutions: 2015 MASS - Product Requirements.

2.2 INSULATION - DUCTWORK

A. Type D-1: Exterior FSK Duct Wrap: Flexible glass fiber; ASTM C553; commercial grade; 'k' value of 0.27 at 75º F; rigid fiber board; ASTM C612, 'k' value of 0.24 at 75° F, 3.0 lb./cu. ft. density. 0.00035 inch foil scrim facing. Minimum thermal performance shall be R=4.8. Johns Manville "Microlite Duct Wrap" and Certainteed "IB board" or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Administrative Requirements: Coordination and project conditions in accordance with MASS 2015.

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 INTALLATION - EQUIPMENT SYSTEMS

A. Factory Insulated Equipment: Do not insulate.

B. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.

C. High Temperature Exhaust Insulation:
   1. Install in multiple layers to meet thickness scheduled.
   2. Attach each layer with bands. Secure first layer with bands before installing next layer.
   3. Stagger joints between layers.
   4. Cover with aluminum jacket with seams located on bottom side of horizontal.

3.3 INSTALATION - DUCTWORK

A. Install materials in accordance with manufacturer's instructions.

B. Provide insulation with vapor barrier when air conveyed may be below ambient temperature. Continue insulation with vapor barrier through penetration.

C. Exterior Insulation (D-1) Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or welded mechanical fasteners to prevent sagging. Secure insulation with mechanical fasteners on 15 inch centers maximum, on bottom and side of ductwork with dimension exceeding 20 inches. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
4. Maximum 25% compression.

D. Where canvas jacketing is indicated, apply mastic in sufficient thickness to completely cover the texture of the canvas material.

3.4 SCHEDULE - DUCTWORK

DUCTWORK	TYPE	INSULATION THICKNESS (Inch)	FINISH
Exhaust & Relief Ducts Within 10 ft. of Exterior Openings	D-1	1" Rigid	Flexible FSK C10", rigid insulation with canvas >10" use in mechanical rooms
Outside Air Intake Ducts	D-1	2" Rigid	CANVAS

END OF SECTION

SECTION 23 09 23 – DIRECT DIGITAL CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions MASS 2015 Specifications Sections, apply to this section.

1.2 RELATED SECTIONS

A. Section 23 09 93 – Sequence of Operation

1.3 GENERAL REQUIREMENTS

A. This section specifies the requirements for the Building Automation System (BAS) to be installed in conjunction with this project.

B. The BAS contractor shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) and electric control for energy management, equipment monitoring and control, and subsystems as specified herein.

C. The BAS contractor shall be responsible for all BAS and temperature control wiring for a complete and operable system. All wiring shall be done in accordance with Division 26 of this specification and all local and national codes.

D. A new PC client workstation is not required. The existing client workstation shall be reused. The existing server shall be updated at the completion of this project to reflect any additions and changes made during this project.

E. All graphics, programming and host databases shall be updated to reflect any changes or additions made under this contract. All programming shall follow the latest revision of the established building automation system standards of the AWWU.

F. The BAS system shall be capable of remote monitoring via the owner's existing Ethernet network. A dedicated Ethernet connection at each DDC controller and operator workstation will be provided by the owner's IT department or as indicated on the electrical drawings.

G. The internal components of any legacy BAS control panels (i.e., SCU, MBC or MEC-type panels) that are directly affected by or modified during this project shall be upgraded to a newer version of Siemens digital control panel to match the rest of the facility's BAS. Existing panel enclosures and raceways may be reused wherever practical.

H. Verify that any existing or new Fire Alarm and Security system monitoring points are connected to the BAS and are functional.

I. All building automation field controllers shall be BTL listed.

J. All BAS field devices shall communicate via the BACnet protocol.

K. The owner shall be supplied with all software, diagnostic equipment, specialty tools, and literature required to operate, maintain, upgrade, modify, and/or replace any of the BAS system components.

L. All actuators controlled by the BAS shall have a dedicated controller. The controller shall be directly attached or in the immediate vicinity of the actuator. The controller shall store scheduling and setpoint information internally and be capable of following the last entered setpoints and scheduling in the event that it is disconnected from exterior controls.

M. The BAS operator dashboard shall be able to adjust all setpoints and view all parameters for field controllers.

N. All controllers and actuators shall be independently replaceable.

1.4 WORK BY OTHERS

A. Products furnished by the BAS contractor for installation by the Mechanical contractor:

1. Control valves.
2. Wells for hydronic temperature sensors.
3. Air Flow Measuring Stations (AFMS), only if specifically requested and shown on drawings and sequence of operation.

B. Products provided and installed by Mechanical contractor:

1. Gauges, thermometers, instrumentation, and thread-o-lets for sensor wells.
2. Control dampers.

C. The Electrical contractor (Division 26) provides:

1. Mounting and power wiring of variable frequency drives (VFDs) furnished by the BAS contractor.
2. Wiring of all power feeds through disconnects and starters to electrical motors.
3. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by the BAS contractor.
4. Duct smoke detectors include installation and wiring.
5. Power wiring.

6. Stand-alone packaged controls and wiring of stand-alone packaged controls to their remote sensors and devices, unless specifically shown on the mechanical drawings.
7. Ethernet data port as required at each of the designated BAS control panels.

1.5 SUBMITTALS / O&M MANUALS

A. All submittals will be bound in white D-ring binders with sufficient ring capacity available for future additions. Electronic submittals are acceptable if directed by the owner.

B. Progression from Submittal to O&M Manual can take place using the same binders as long as all applicable material is properly updated.

C. Prior to beginning on-site installation, the BAS contractor will submit four (4) complete sets of documentation containing the following:

1. Sequence of Operations (Designer to provide electronic text version)
2. Riser Diagrams
3. Control Diagrams
4. Panel layout(s)
5. Point Summary Report
6. Product Data

D. The O&M Manuals will consist of the following:

1. Sequence of Operations
2. Riser Diagrams
3. Control Diagrams
4. Panel layouts
5. Point Summary Report
6. Commented Program Code
7. Trend Logs
8. Product Data

1.6 INSTALLATION SCHEDULING AND COORDINATION

A. If this is an existing facility, it may require interface with the existing system. Provide an appropriate interface with the existing system as required. Maintain operation of the existing DDC system during construction as required.

B. Remove any existing controls-related wiring and electrical conduit that is not reused as part of the new building automation system. Do not abandon in place.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers are limited to the following:
   1. Siemens Industry, Inc. 5333 Fairbanks St., Ste. B, Anchorage, AK 99518. Contact Siemens at (907) 563-2242 for specific questions.
   2. No substitutions, No alternate brands accepted.

2.2 NETWORKING COMMUNICATIONS

A. The design of the BAS shall network one new operator workstation and stand-alone DDC Controllers. The network architecture shall consist of three levels; a campus-wide Management Level Network (MLN) Ethernet network based on TCP/IP protocol, a high-performance building level network (BLN) and DDC Controller floor level local area networks (FLN). Access to the system shall be totally transparent to the user when accessing data or developing control programs.

B. The design of the BAS shall allow the co-existence of both new and existing DDC Controllers on the same network without the use of gateways, protocol converters, or third-party interface devices.

C. Management Level Network (MLN)

   1. Personal Computer workstations shall directly connect to the Ethernet and Management Level Network without the use of an interposing device.
   2. The Management Level Network shall not impose a maximum constraint on the number of operator workstations.
   3. Simultaneous user access to the network shall be limited to the number of user licenses currently issued to AWWU.
   4. DDC controllers residing on the building level network shall connect directly to the Ethernet network.
   5. Any PC on the Ethernet Management Level Network shall have transparent communication with controllers on the building level networks connected via Ethernet as well as directly connected building level networks. Any PC shall be able to interrogate any controller on the building level network in addition to being able to download program changes to individual controllers.
   6. The Management Level Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3.
   7. Access to the system database shall be available from any client workstation on the Management Level Network.

D. Building Level Network (BLN)

   1. Data transfer on the Building Level Network (BLN) shall be via Ethernet on all new DDC panel installations. RS-485 communication is only

allowed for existing BLN networks, or in locations where Ethernet connectivity is not available or possible.

E. Floor Level Network (FLN)

1. The Floor Level Network (FLN) communication shall support a family of application specific controllers and shall communicate with the building level network through DDC Controllers for transmission of global data.

2.3 HVAC CONTROLLERS

A. New digital HVAC controllers shall be manufactured by Siemens. Controllers shall be a 12-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors.

B. Each HVAC Controller shall have sufficient memory to support its own operating system and databases, including:

1. Control processes
2. Energy management applications
3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
4. Historical/trend data for points specified.
5. Maintenance support applications
6. Custom processes
7. Operator I/O
8. Remote communications

C. HVAC Controllers shall provide a RS-232C serial data communication port or USB port for operation of operator I/O devices.

D. HVAC Equipment Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.

E. Each HVAC Equipment Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all components. The HVAC Equipment Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

F. All control devices located in exposed areas subject to outside weather conditions shall be mounted inside weatherproof enclosures. The location of each panel shall be convenient for adjustment service.

G. Nameplates shall be provided beneath each panel face mounted control device describing the function of each device. Nameplates shall have white letters engraved on black Lamicoid plates that identify the panel name and number.

H. All control panels shall bear a UL label compatible with the application.

I. All electrical devices within the panel shall pre-wired to terminal strips with all inter-device wiring within the panel completed prior to installation of the system.

2.4 TEMPERATURE SENSORS

A. All electronic temperature sensors shall be of standard resistance type for all temperature ranges. All electronic temperature sensors shall be factory calibrated and of tamper proof construction requiring no field calibration. Temperature sensor accuracy shall be a minimum of +/- 0.5 degrees Fahrenheit. To ensure system accuracy, a common sensor shall be used for each control zone to provide control, indication (local and central), alarm indication (local and central) and where multi-control functions, such as discharge temperature control with compensation and positive high and low limits are used.

B. Where the sensor is used for makeup air unit coil discharge temperatures, and/or the duct area cross-section is in excess of 14 square feet, the instrument shall incorporate an averaging element. Outside air sensing shall be accomplished using a sensing element and transmitter shielded from the effects of sunlight.

C. S7ensors shall be furnished in scale ranges compatible with system operating range.

D. Where sensors are used for sensing liquid temperatures, they shall be furnished with separable wells or appropriate material.

E. Electronic Room Temperature Sensors: Shall be 1,000-ohm RTD type with 35-degree F to 95-degree F range. Optional features include: LED display. Covers shall be robust, of institutional quality, and suitably finished. Provide sensing-only, stainless-steel flush-mount covers where indicated on the drawings or as required to meet AWWU standards.

F. All sensors to be labeled per (section) with unit number being controlled.

2.5 HIGH AND LOW LIMIT THERMOSTATS

A. Low limit thermostats shall employ a 20-foot element. If any one-foot section of the element is subjected to temperatures below 35 degrees F (adjustable), the respective electric or pneumatic circuit shall open causing action to fans and dampers as required under the sequence of operation.

B. High limit thermostats shall employ rod and tube type elements that extend approximately ten inches into the duct. If the instrument is subjected to temperatures above 135 degrees F, the action required by sequence of operations shall occur. Where a high limit is required for fire protection, such thermostats shall be UL listed for fire protection.

C. Shall be manual reset or automatic reset with time delay. Manual resets will have alarmable contacts.

2.6 PRESSURE GAUGES AND THERMOMETERS

A. To be provided and installed by the mechanical contractor as specified elsewhere.

2.7 INTERPOSING RELAYS AND SIGNAL TRANSMITTERS

A. All necessary interposing relays and signal transmitters shall be furnished to make the system a full and operable system as required by the Sequence of Operations.

2.8 AIR FLOW PROOF DEVICES

A. Provide current-sensing relays as standard proof devices for all fan motors. Pressure differential switches and paddle type flow switches are not acceptable.

1. Provide solid-state, adjustable, current operated relay. Provide a relay that changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit.
2. Adjust the relay switch point so that the relay responds to motor operation under load as an ON state and so that the relay responds to an unloaded running motor as an OFF state. A motor with a broken belt is considered an unloaded motor.

B. Provide status device for any fans, motors, and pumps as reference in the Points List or Sequence of Operations.

2.9 DIFFERENTIAL PRESSURE SWITCHES

A. Provide air differential pressure switches as called out in the sequence of operation and the input/output summary. Switches shall be diaphragm operated SPDT snap switch with ranges from 0.05” to 12.0” w.g.

2.10 DUCT STATIC OR VELOCITY PRESSURE TRANSMITTERS

A. Provide integral pressure transducer and transmitter in enclosure suitable for external duct mounting. 4-20ma output proportional to the input pressure span. Transmitter range shall be selected so that the normal operating setpoint is midway between the upper and lower range of the transmitter. Each transmitter shall have a field adjustable span and zero adjustments for field calibration. Accuracy + 1.0% of full scale. Linearity + 0.1%.

2.11 ROOM STATIC PRESSURE TRANSMITTERS

A. Provide integral pressure transducer and transmitter in enclosure suitable for wall or panel mounting. 4-20ma output proportional to the input pressure span. Transmitter range shall be selected so that the normal operating setpoint is

midway between the upper and lower range of the transmitter. Each transmitter shall have a field adjustable span and zero adjustments for field calibration. Accuracy + 1.0% of full scale. Linearity + 0.1%. Outside sensors shall be protected from wind induced pressure effects.

2.12 DAMPER ACTUATORS

A. Electric control shall be by Siemens. Damper actuators shall be brushless DC Motor Technology with stall protection, bi-directional, fail-safe spring return, all metal housing, manual override, independently adjustable dual auxiliary switch. Actuators shall be designed for mounting directly to the damper shaft without the need for connecting linkages.

B. Provide actuators in sufficient size, quantity, and type to match the application. Provide a minimum of one damper actuator for each 20 square feet of damper area.

C. Damper actuators shall be spring return as indicated by Normally Closed or Normally Open designation on drawings or in sequence of operation.

2.13 AIR FLOW MEASURING STATIONS

A. Air flow measuring stations are not required for this project.

2.14 FLAMMABLE GAS DETECTORS (TO BE COORDINATED WITH ELECTRICAL)

A. Acceptable Manufacturers: Drager/Siemens as required to meet the application.

B. Provide flammable gas detectors where indicated on the plans.

PART 3 - EXECUTION

3.1 RELATED DOCUMENTS

A. Refer to General Conditions, Basic Materials and Methods and Division 26.

3.2 GENERAL

A. Do not install control devices in locations where they are subject to damage or malfunction due to normally encountered ambient temperatures.

B. Mount damper operators and other control devices secured to insulated ductwork on brackets such that the device is external of the insulation.

3.3 IDENTIFICATION

A. All controllers, switches, relays, thermostats, and actuators shall be permanently tagged for identification.

B. The tagging scheme shall be reflected on the control drawings.

C. Submit proposed identification method, specifically listing each device and the identification tag to be applied.

3.4 INSTALLATION AND WIRING

A. Install, connect, and wire the items included under this Section and Division 26 requirements. This work includes providing required conduit, wire, fittings, and related wiring accessories. All wiring in exposed or inaccessible areas shall be installed as specified in Division 26. Plenum-rated cable may be used in concealed, accessible areas only, such as plenums above suspended ceilings or raised floors.

B. Provide wiring between thermostats and unit heater motors, and all control and alarm wiring.

C. Provide conduit and wiring between the BAS panels and the temperature, humidity, or pressure sensing elements, including low voltage control wiring in conduit or plenum-rated cable.

D. Provide conduit and control wiring for devices specified in this Section and Division 26 requirements.

E. Plenum-rated cabling is acceptable in concealed, accessible spaces. All exposed control wiring and all wiring in mechanical rooms shall be installed as specified in Division 26.

F. Provide conduit and signal wiring between motor starters in motor control centers and high and/or low temperature relay contacts and remote relays in BAS panels located in the vicinity of motor control centers.

G. Provide conduit and wiring between the sensors, metering, instrumentation, indicating devices, miscellaneous alarm points, remotely operated contactors, and BAS panels, as shown on the drawings or as specified.

H. All wiring to be compliant with the Division 26 requirements and the NEC.

I. Provide electrical wall boxes and conduit sleeves for all wall-mounted devices. Mount thermostats at 48 inches AFF unless otherwise noted.

3.5 WARRANTY

A. Upon completion of the project, as defined in the Contract Conditions, a warranty period of two (2) years shall commence. The warranty shall consist of a

commitment by the BAS contractor to provide, at no cost to the Owner, parts and labor as required to repair or replace such parts of the control system that prove inoperative due to defective materials or installation practices. The warranty expressly excludes routine services such as instrument calibration.

3.6 TREND LOGS

A. BAS contractor shall prepare trend logs for all points required to show system calibration and stability.

B. These logs shall document building operation after the installation, balancing and calibration is completed and after the control system is fully operational. Setpoints, valve positions, etc. shall be adjusted to artificially induce the sequences to occur.

C. Digital/Binary Inputs trend set up as a COV at 1.0 change. Repository enabled.

D. Analog inputs trend set-up as timed every 600 seconds. Repository enabled.

3.7 COMMISSIONING AND SYSTEM DEMONSTRATION

A. Comply with any commissioning requirements specified in the contract documents.

B. BAS contractor shall demonstrate complete and proper operation of all systems per the Sequence of Operations.

C. The demonstration shall include, but not necessarily be limited to, the following:

1. Review of the Trend Logs.
2. Complete and proper operation of control systems including simulations.
3. Access to all devices for required maintenance.
4. Review of associated graphics on the operator workstation.

3.8 TRAINING

A. Two each four (4) hour sessions of on-site instruction will be provided by the BAS contractor to familiarize operating personnel with the control system. instructions will include:

1. A brief description of the controls' sequence of operation.
2. A discussion and explanation of all alarms, switches, and gauges.
3. A summary and explanation of steps to be taken in response to specific alarms or control malfunctions.
4. Building walk-through to physically locate and examine all control devices and demonstrate control setpoint adjustment procedures.
5. Instructions regarding adjustment procedures shall emphasize methods for continual building "fine-tuning".

3.9 SEQUENCE OF OPERATION

A. Reference: Section 23 09 93 – Sequence of Operation or as stated on contract drawings. If no sequence of operation is provided, then provide sequences that meet the latest published version of the AWWU Building Automation System standards maintained by AWWU and Siemens Controls.

END OF SECTION

SECTION 23 09 93 – SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

1. Sequence of Operations for Control System, requirements for system control operation, alarms, and monitoring.

1.2 RELATED SECTIONS

1. Section 23 05 00 - Common Work Results for HVAC
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
3. Section 23 05 48 - Vibration and Seismic controls for HVAC Piping, Ductwork and Equipment
4. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment
5. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 00 - HVAC Insulation
7. Section 23 09 00 – HVAC Instrumentation
8. Section 23 09 23 - Direct Digital Control System for HVAC
9. Section 23 31 00 - HVAC Ducts and Casings
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 00 - HVAC Fans
12. Section 23 37 00 - Air Outlets and Inlets

1.3 SYSTEM DESCRIPTION

1. This Section defines the manner and method by which the controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other Sections.

2. Submit under provisions of MASS Section 10.05 Article 5.6.

3. Submit diagrams indicating mechanical system controlled and control system components. Label with settings, adjustable range of control and limits. Include written description of control sequence.

4. Include flow diagrams for each control system, graphically depicting control logic.

5. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

6. The following critical alarms shall be sent to the AWWU central alarm monitoring station (coordinate with AWWU project manager):

    1. Building low temperature alarm.
    2. Electrical phase loss.
    3. Low supply temp - priority 66.
    4. Makeup Air supply fan failure/VFD fault
    5. Low exhaust air flow alarm.
    6. Other critical alarm items at the discretion of the AWWU project manager.

1.4 PROJECT RECORD DOCUMENTS

1. Submit documents under provisions in accordance with MASS 2015.

2. Accurately record actual setpoints and settings of controls, including changes to sequences made after submission of shop drawings.

1.5 COMMISSIONING

1. Fully commission all systems, subsystems and equipment that provides control function. Provide demonstration of all control functions for each item of mechanical equipment to the owner and the Owner’s representative at substantial completion. Provide on-site demonstration and functional verification.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 MAKEUP AIR UNIT (MAU-2)

1. Alarms:

    1. Low supply air temperature (35°F adjustable) after 10 minutes.
    2. Supply fan failure/VFD fault.
    3. Freeze alarm.
    4. Filter alarm

2. Digital Control and Indication.

    1. H-O-A control.
    2. On-off indication.
    3. Supply fan/VFD status indication.
    4. Duct static pressure indication.
    5. Filter differential pressure indication.
    6. Building static pressure setpoint.
    7. Building pressure differential indication.
    8. Supply air temperature setpoint in degrees Fahrenheit.
    9. Supply air temperature indication in degrees Fahrenheit.
    10. Supply air volume indication in CFM.
    11. Outside air temperature indication in degrees Fahrenheit.
    12. Alarm setpoints.

3. Automated Control:

    1. Operation Mode: Occupied and Unoccupied Low Ambient will be controlled by the DDC system. The unit is to operate continuously in all modes of operation. Unit is interlocked with Exhaust fan EF-2.
    2. Occupied Mode: When occupancy is detected through building SCADA badging system the fan speed increases to provide 12 air changes an hour, 2,690 CFM. Low Flow Alarm shall activate if supply air goes below 2,690 CFM for 10 minutes.
    3. Unoccupied Low Ambient Mode: When building is unoccupied and MAU-2 outside air intake temperature below 60 degrees F is detected for 60 minutes the fan speed decreases to provide 1,345 CFM. If supply air is detected below 1,345 CFM for 10 minutes while in unoccupied low ambient mode, the unit shall go to occupied mode.

4. MAU-2 integral outside air damper shall remain open when unit is in operation.
5. Supply Air Heating: In both occupancy modes, the unit is to maintain a constant 60 degrees F supply air temperature via integral modulating gas valve when outside intake air temperature is below 60 degrees F. Burner to shut off if outside intake air is above 60 degrees F for 60 minutes.
6. Building Air Pressure Control: During unoccupied low ambient mode the DDC shall override operation mode to occupied if dry well space is not maintaining +0.1" WC relative to the outside or wet well access is not maintaining -0.1" WC relative to the outside for 30 minutes.
7. Emergency Mode: upon detection above 10% of the lower flammable limit by the combustible gas detection (CGD) systems the building operation shall automatically be overridden and placed into occupied mode until the CGD alarm is cleared.

3.2 EXHAUST FAN (EF-2)

1. Alarms:

    1. Fan Failure/VFD Fault.
    1. Low flow alarm.

2. Digital Control and Indication:

    1. H-O-A control.
    2. On-off indication.
    3. Wet well access to ambient outside pressure (+0.1" WC)

3. Automated Control:

    1. Operation Mode: Occupied and Unoccupied Low Ambient will be controlled by the DDC system. The unit is to operate continuously in all modes of operation. Fan shall be interlocked with Makeup Air Unit, MAU-2.
    2. Occupied Mode: When occupancy is detected through building SCADA badging system the fan speed increases to provide approximately 1,265 CFM and modulates to maintain wet well access area pressure at -0.1" WC relative to outside ambient.
    3. Unoccupied Mode: Exhaust fan shall operate at 50% flow to provide six air changes and hour, 633 CFM, to Wet Well Access and Wet Well Access Fan Room.
    4. Emergency Mode: upon detection above 10% of the lower flammable limit by the combustible gas detection (CGD) systems the building operation shall automatically be overridden and placed into occupied mode until the CGD alarm is cleared.

3.3 EXHAUST FAN (EF-3)

1. Alarms:

    1. Fan Failure/VFD Fault.
    2. Low flow alarm.

2. Digital Control and Indication:

    1. H-O-A control.
    2. On-off indication.

3. Automated Control:

    1. Operation Mode: Occupied and Unoccupied Low Ambient will be controlled by the DDC system. The unit is to operate continuously in all modes of operation.
    2. Occupied Mode: When occupancy is detected through badging system the fan speed increases to provide approximately 1,425 CFM.
    3. Unoccupied Mode: Exhaust fan shall operate at 50% flow to provide six air changes and hour, 713 CFM, to Wet Well Access and Wet Well Access Fan Room.
    4. Emergency Mode: upon detection above 10% of the lower flammable limit by the combustible gas detection (CGD) systems the building operation shall automatically be overridden and placed into occupied mode until the CGD alarm is cleared.

END OF SECTION

SECTION 23 11 23 – FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Natural gas piping above grade.
   2. Unions and flanges.
   3. Valves.
   4. Pipe hangers and supports.
   5. Natural gas pressure regulators.
   6. Pipe coating.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI Z21.15 - Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.

B. American Society of Mechanical Engineers:
   1. ASME B16.3 - Malleable Iron Threaded Fittings.
   2. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
   3. ASME B31.9 - Building Services Piping.

C. ASTM International:
   1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   2. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
   3. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
   4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

D. American Welding Society:
   1. AWS D1.1 - Structural Welding Code - Steel.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
   2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
   3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
   4. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

F. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.

G. Underwriters Laboratories Inc.:
   1. UL 842 - Valves for Flammable Fluids.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.

C. Provide pipe hangers and supports in accordance with MSS SP 58.

D. Use ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4 SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

B. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
   2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
   3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
   4. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
      a. Natural gas pressure regulators.

C. Test Reports: Indicate results of piping system pressure test.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements shall be in accordance with MASS 2015.

B. Project Record Documents: Record actual locations of valves, piping system, and system components.

C. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists.

1.6 QUALITY ASSURANCE

A. Perform natural gas work in accordance with NFPA 54.

B. Perform work in accordance with applicable code and ENSTAR requirements.

C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

D. Perform Work in accordance with authority having jurisdiction AWS D1.1 for welding hanger and support attachments to building structure.

E. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

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

1.7 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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be in accordance with MASS 2015.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

B. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

C. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer's written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53 Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron.
   2. Joints: Threaded for pipe 2 inch and smaller.

B. Steel Pipe: ASTM A53 Schedule 40 black.
   1. Fittings: Cold Press Mechanical Joint Fitting, ASME B16.3, ASTM F3226. MegaPressG or approved equal.

2.2 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:
   1. Ferrous Piping: Class 150, malleable iron, threaded.

2.3 BALL VALVES

A. 1/4 inch to 2 inch: MSS SP 110, Class 125, two-piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.

2.4 GAS COCKS

A. Up to 2 Inches: Bronze body, bronze tapered plug. non-lubricated, Teflon packing, threaded ends.

2.5 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
   1. ERICO International Corporation
   2. PHD Manufacturing, Inc.
   3. B-Line Systems, Inc
   4. Substitutions: 2015 MASS - Product Requirements.

B. Conform to NFPA 54 and MSS SP 58.

C. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or carbon steel, adjustable swivel, split ring.

D. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.

E. Vertical Support: Steel riser clamp.

2.6 NATURAL GAS PRESSURE REGULATORS

A. Manufacturers:
   1. Fisher Control Valves & Instruments
   2. Maxitrol Company
   3. Substitutions: 2015 MASS - Product Requirements.

B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
   1. Comply with ANSI Z21.80.
   2. Temperatures: minus 20 degrees F to 150 degrees F.
   3. Body: Aluminum or cast iron.
   4. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
   5. Disk, diaphragm, and O-ring: Nitrile.
   6. Maximum inlet pressure: 150 psig.
   7. Furnish sizes 2 inches and smaller with threaded ends.

2.7 NATURAL GAS PIPE COATING SYSTEM

A. Above Grade Exterior 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, topcoat primed pipe and fittings with two coats of ALKYD enamel (Devoe Speedenamel 4318 OAE) to 2.0 mils DFT. Color shall be safety yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 2015 MASS - Administrative Requirements: Coordination and project conditions.

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.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with MSS SP 89.

B. Support horizontal piping hangers as scheduled.

C. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Install hangers to allow 1-1/2-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

F. Support riser piping independently of connected horizontal piping.

3.4 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

B. Provide non-conducting dielectric connections wherever joining dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Where required, bend pipe with pipe bending tools in accordance with procedures intended for that purpose.

E. Install piping to conserve building space and not interfere with use of space.

F. Size and install gas piping to provide sufficient gas to supply maximum appliance demand at pressure higher than appliance minimum inlet pressure.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

H. Sleeve pipe passing through partitions, walls, and floors.

I. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.

J. Provide clearance for installation of insulation and access to valves and fittings.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.

L. Provide support for utility meters in accordance with the requirements of utility company.

M. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood. Protect vent against entry of insects and foreign material.
   1. Minimum Vent Size: Connection size at regulator vent connection.
   2. Run individual vent line from each relief device, independent of breather vents.

N. Install valves with stems upright or horizontal, not inverted.

O. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

P. Install gas pressure regulator with independent vent full size opening on regulator and terminate outdoors.

Q. Provide new gas service complete with gas meter and regulators. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.5 FIELD QUALITY CONTROL

A. All field inspecting, testing, adjusting, and balancing shall be in accordance with MASS 2015.

B. Where gas appliance will be damaged by test pressure, disconnect appliance and cap piping during pressure test. Reconnect appliance after pressure test and leak test connection.

C. Where gas appliance is designed for operating pressures equal to or greater than piping test pressure, provide gas valve to isolate appliance or equipment from gas test pressure.

D. Pressure test natural gas piping in accordance with NFPA 54.

E. Inspect, test and purge gas piping in accordance with applicable code and ENSTAR requirements.

F. Where new branch piping is extended from existing system, pressure test new branch piping only. Leak test joint between new and existing piping with noncorrosive leak detection fluid or other approved method.

G. When pressure tests do not meet specified requirements, remove defective work, replace and retest.

H. Immediately after gas is applied to a new system, or a system has been restored after gas service interruption, check pipe for leakage.
   1. Where leakage is detected, shut off gas supply until necessary repairs are complete.

I. Do not place appliances in service until leak testing and repairs are complete.

3.6 SCHEDULES

A. Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING MINIMUM HANGER ROD DIAMETER Inches	STEEL PIPE MINIMUM HANGER ROD DIAMETER Inches
1/2	4	6	3/8	3/8
3/4	6	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	8	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8

END OF SECTION

SECTION 23 31 00 – HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Low pressure ducts.

1.2 RELATED WORK

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

B. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping, Ductwork and Equipment

D. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment

E. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

F. Section 23 07 00 - HVAC Insulation

G. Section 23 09 23 - Direct Digital Control System for HVAC

H. Section 23 33 00 - Duct Accessories

I. Section 23 34 00 - HVAC Fans

J. Section 23 37 00 - Air Outlets and Inlets

1.3 REFERENCES

A. ASTM International:

1. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
2. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
3. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
4. ASTM A 525 - General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process.
5. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

B. American Society of Heating, Refrigerating and Air Conditioning Engineers:

1. ASHRAE - Handbook Fundamentals; Duct Design.
2. ASHRAE - Handbook Equipment; Duct Construction.

C. American Society of Civil Engineers

1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures, Latest adopted Edition.

D. International Code Council:

1. IBC – International Building Code, Latest Adopted Edition.

E. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

F. Sheet Metal and Air Conditioning Contractors:

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

G. Underwriters Laboratories Inc.:

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

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three years of experience.

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

1.5 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Three pressure classifications: ½ inch WG positive or negative static pressure and velocities less than 2,000 fpm.

1.6 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A and NFPA 90B standards.

1.7 SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

B. Product Data: Submit data for duct materials.

1.8 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2016, Section 5 – “Systems and Equipment” and Section 7 – “Construction and System Start-Up.”

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2016, Section 6.4.4 – “HVAC System Construction and Insulation.”

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

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealant.

1.10 FIELD MEASURMENTS

A. Before ordering or fabricating 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.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be in accordance with MASS 2015.

B. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.12 WARRANTY

A. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

B. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

C. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer's written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

1.13 PERFORMANCE REQUIREMENTS

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

1.14 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements shall be in accordance with MASS 2015.

B. Project Record Documents: In addition to other requirements in MASS 2015, record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.

B. Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz. per sq. ft. for each side in conformance with ASTM A90.

C. Stainless Steel Ducts: ASTM A666 stainless steel sheet, lock-forming quality.

D. Fasteners: Rivets, bolts, or sheet metal screws.

E. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic. Maximum VOC content of 75 g/L.

F. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 LOW PRESSURE DUCTWORK

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Support in accordance with the IBC and SMACNA HVAC Duct Construction Standards.

C. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.

D. Construct T's, bends, and elbows with radius of not less than 1-½ times width of duct on centerline. Where not possible and where rectangular elbows are used, provide [air foil] turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

E. Increase duct sizes gradually, not exceeding 15º divergence wherever possible. Divergence upstream of equipment shall not exceed 30º; convergence downstream shall not exceed 45º.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

C. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inch and smaller.

D. Install duct hangers and supports in accordance with Section 23 05 29.

E. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

F. For outdoor ductwork, protect ductwork, ductwork supports, linings and coverings from weather.

G. Exhaust Outlet Locations:

1. Minimum Distance from Property Lines: 3 feet.

2. Minimum Distance from Building Openings: 3 feet.
3. Minimum Distance from Outside Air Intakes: 10 feet.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.

B. Connect air outlets and inlets to supply ducts directly. Flex duct not allowed. Do not use flexible duct to change direction.

3.3 DUCTWORK SCHEDULE

Air System	Material
Low Pressure Supply	Galvanized Steel
Exhaust EF-2	Stainless Steel
Exhaust EF-3	Stainless Steel
Outside Air Intake	Galvanized Steel

END OF SECTION

SECTION 23 33 00 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Control Dampers
   2. Back Draft Dampers
   3. Duct Access Doors
   4. Flex Duct Connectors
   5. Duct Test Holes

B. Related Sections:
   1. Section 23 31 00 - HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:
   1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. ASTM International:
   1. ASTM E1 - Standard Specification for ASTM Thermometers.

C. National Fire Protection Association:
   1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

D. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

E. Underwriters Laboratories Inc.:
   1. UL 555C - Standard for Safety for Ceiling Dampers.

1.3 SUBMITTALS

A. Submit Shop Drawings in accordance with MASS Section 10.05 Article 5.5.
   1. Indicate for shop fabricated assemblies including volume control dampers and duct access doors.

B. Submit Product Data in accordance with MASS Section 10.05 Article 5.6: Submit data for shop fabricated assemblies and hardware used.

1. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.
2. Submit for the following. Include where applicable electrical characteristics and connection requirements.

1.4 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements shall be in accordance with MASS 2015.

B. Operation and Maintenance Data: Submit instructions for lubrication, maintenance, and operation.

1.5 QUALITY ASSURANCE

A. Dampers tested, rated and labeled in accordance with the latest UL requirements.

B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

C. Perform Work in accordance with Municipality of Anchorage and State of Alaska standards.

1.6 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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be in accordance with MASS 2015.

B. Protect dampers from damage to operating linkages and blades.

C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

D. Storage: Store materials in a dry area indoor, protected from damage.

E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.8 MATERIALS

A. In accordance with MASS Section 10.05 Article 5.7, all materials and equipment furnished under the Contract shall be new, unless otherwise specified, and shall be of good quality, free from defects, and shall conform to the requirements of the Contract Documents.

B. In accordance with MASS Section 10.05 Article 5.7, substitute materials shall not be used unless approved through the substitution request process by the Engineer in writing prior to installation. 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.

1.9 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 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.

1.12 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.

1.13 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.

1.14 COMPLETION REQUIREMENTS

A. Project closeout requirements shall be in accordance with MASS 2015; 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.

1.15 WARRANTY

A. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

B. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

C. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer's written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

PART 2 - PRODUCTS

2.1 CONTROL DAMPERS

A. Acceptable Manufacturers:
   1. Ruskin.
   2. Louvers and Dampers, Inc.
   3. Substitutions: 2015 MASS - Product Requirements.

B. Multi-blade, opposed blade action, control dampers of extruded aluminum, with airfoil type blades of maximum six-inch width, blades positioned across short air opening dimension, field replaceable extruded vinyl sealed edges, linked together in rattle-free manner, non-corrosive molded synthetic bearings, square or hexagonal axles for positive locking connection to blades and linkage, with documented leakage rate not to exceed 6 CFM/sq. ft. at 4 inch W.G.

2.2 BACK DRAFT DAMPERS

A. Acceptable Manufacturers:
   1. Ruskin.
   2. Louvers and Dampers, Inc.
   3. Substitutions: 2015 MASS - Product Requirements.

B. Multi-blade, Parallel blade action, backdraft dampers of extruded aluminum, with airfoil type blades of maximum six-inch width, blades positioned across short air opening dimension, field replaceable extruded vinyl sealed edges, linked

together in rattle-free manner, non-corrosive molded synthetic bearings, square or hexagonal axles for positive locking connection to blades and linkage, designed to prevent backflow at static pressures up to 20 in. wg and velocities up to 2500 ft/min.

2.3 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

B. Review locations prior to fabrication.

C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one-inch-thick insulation with sheet metal cover.

D. Access doors smaller than 12 inches square may be secured with sash locks.

E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

F. Access doors with sheet metal screw fasteners are not acceptable.

2.4 FLEX DUCT CONNECTORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz. per sq. yd., approximately 3 inches wide, crimped into metal edging strip.

C. Leaded vinyl sheet, minimum 0.55 inch thick, 0.87 lbs. per sq. ft., 10 dB attenuation in 10 to 10,000 Hz range.

2.5 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordination and project conditions in accordance with MASS 2015

B. Verify duct and equipment installations are ready for accessories.

3.2 INSTALLATION

A. Install in accordance with NFPA 90A and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

B. Install accessories in accordance with manufacturer's instructions. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Locate dampers a minimum 15 feet upstream of all air inlets and outlets.

C. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Cover connections to medium and high-pressure fans with leaded vinyl sheet, held in place with metal straps.

E. Provide duct access doors for inspection and cleaning before and after filters, fans, automatic dampers, and elsewhere as indicated. Provide minimum 8 x 8-inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated.

F. Provide duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION

SECTION 23 34 00 – HVAC FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Centrifugal Fans

1.2 RELATED WORK

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

B. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

C. Section 23 05 48 - Vibration and Seismic controls for HVAC Piping, Duct- work and Equipment

D. Section 23 05 53 - Identification for HVAC Piping, Ductwork and Equipment

E. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

F. Section 23 07 00 - HVAC Insulation

G. Section 23 09 23 - Direct Digital Control System for HVAC

H. Section 23 31 00 - HVAC Ducts and Casings

I. Section 23 33 00 - Duct Accessories

J. Section 23 37 00 - Air Outlets and Inlets

1.3 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

E. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

F. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

G. SMACNA - Low Pressure Duct Construction Standard.

1.4 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. Balanced: All fans shall be balanced in accordance with AMCA Standard 204-96 fan application category BV-3.

D. Fabrication: Conform to AMCA 99.

1.5 SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.

C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Submit fan manufacturer’s instructions.

1.6 OPERATION AND MAINTENANCE DATA

A. Execution and Closeout Requirements shall be in accordance with MASS 2015.

B. Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be in accordance with MASS 2015.

B. Protect motors, shafts, and bearings from weather and construction dust.

1.8 FIELD MEASUREMENTS

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.

1.9 WARRANTY

A. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

B. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

C. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer's written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTUERS

A. Hartzell.

B. Greenheck.

C. Substitutions: 2015 MASS - Product Requirements.

2.2 GENERAL

A. Fans shall be belt drive backward curve utility sets. Fan housing shall be field rotatable and the fan shall be provided from the factory completely assembled, packaged, and ready to install.

B. Fans used shall not decrease motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Fans shall be capable of accommodating static pressure variations of plus or minus 10 percent.

C. Base performance on sea level conditions.

D. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.

2.3 WHEEL

A. Backward Inclined: The wheel type shall be FA. The resin used on the solid fiberglass wheel shall be Dow Derkane 510-A vinylester or equal. Blades shall be backward curved to provide non-overloading, highly efficient operation.

B. Wheel: The wheel shall have a totally encapsulated aluminum core insert for secure attachment to the shaft. The wheel shall be one piece, resin transfer molded, without hand lay-up or assembly components. The fan shall be suitable for temperatures up to 200^{o}F.

2.4 HOUSING

A. The fan housing shall be constructed of a polyester resin and glass fiber with antimony trioxide added to achieve a ClassI flame spread below 25. Fan construction shall conform to ASTM Standard D4167 for fiber reinforced plastic fans and blowers.

B. All fiberglass surfaces shall be protected with a minimum of 10 mil thickness chemical, flame, and ultraviolet resistant resin. The inlet cone shall be solid fiberglass. The entire housing shall have a finish coat of resin to provide a smooth airflow.

C. All airstream hardware shall be 304 stainless steel. The fan drive base shall be epoxy coated steel.

2.5 MOTORS AND DRIVES

1. Motor enclosures: TEFC
2. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications.
3. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
5. Motor shall be speed controllable down to 50% of full speed (50% turndown). Speed shall be controlled by a 0-10 VDC signal.

B. Bearings: ANSI/AFBMA 9, L-10 life at 50,000 hours heavy duty pillow block type, self-aligning, grease-lubricated ball bearings.

C. Shafts: Shall be grounded and polished carbon steel with an FRP sleeve in the air stream. A neoprene shaft seal shall be located where the shaft enters the housing with a neoprene slinger between the seal and the wheel.

D. V-Belt Drive: Shall be sized for continuous service.

E. Safety Guard: Made of epoxy coated steel.

2.6 Accessories

A. Vibration Isolation:

1. Sized to match the weight of each fan.
2. Provide for horizontal floor mount.

B. Disconnect Switches:

1. Positive electrical shut-off
2. Wired from fan motor to junction box installed within motor compartment.

C. Access Doors: Raised bolted door held in place with stainless steel bolts and gasketed.

D. Inspection Door: Provide small opening for visual inspection of wheel. Gasketed and held in place with stainless steel bolts. .

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Install fans as specified, with resilient mountings and flexible electrical leads.

C. Install flexible connections specified in Section 23 33 00 between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

D. Install fan restraining snubbers. Flexible connectors shall not be in tension while running.

E. Provide sheaves required for final air balance.

F. Provide safety screen where inlet or outlet is exposed.

G. Provide backdraft dampers on discharge of exhaust fans and as indicated.

H. Ground equipment at installation, in accordance with manufacturer installation instructions.

END OF SECTION

23 37 00 – AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grilles.

2. Louvers.

1.2 RELATED WORK

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

1.3 REFERENCES

A. ADC 1062 - Certification, Rating and Test Manual.

B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

D. ARI 650 – Air Outlets and Inlets.

E. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

F. SMACNA - HVAC Duct Construction Standard.

1.4 SUBMITTALS

A. Submit Shop Drawings in accordance with MASS Section 10.05 Article 5.5.

1. Submit Product Data in accordance with MASS Section 10.05 Article 5.6

B. Product Data: Submit data including capacity, free area, and pressure drop on each type of diffuser to be used.

C. Manufacturer's Installation Instructions: Submit special procedures and assembly of components.

1.5 QUALITY ASSURANCE

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

1.2 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be in accordance with MASS 2015.

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

1.7 WARRANTY

A. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

B. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

C. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer's written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

PART 2 - PRODUCTS

2.1 DUCT MOUNTED DIFFUSERS

A. Acceptable Manufactures:

1. Titus.

2. Substitutions: 2015 MASS – Product Requirements.

B. Construction to be 304 stainless steel. Capacities and dimensions to match drawings.

C. Sizes and mounting types to be as shown on plans and outlet schedule. Deflection blades shall be parallel to the long dimension of the grille.

D. Paint and finish shall be white baked on power coat with antimicrobial additives.

2.2 LOUVERS

A. Acceptable Manufactures:

1. Ruskin.

2. Substitutions: 2015 MASS – Product Requirements.

B. Construction to be all welded fixed blade type with frame and blades made from extruded aluminum with 57% Free Area. Drain gutter in each blade to minimize water cascading between blades.

C. Beginning point of water penetration at 0.01 oz. per square foot to be 1023 feet per minute.

D. Pearledize coating shall be applied and baked to achieve a hard durable finish in compliance with either AAMA 2605 as selected and specified. Color shall be Herringbone. Finish to be a high pearlescent finish that is 50% PVDF based. A ten-year warranty shall be available on standard colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Install diffusers to ductwork with airtight connection.

END OF SECTION

SECTION 25 34 13 13 – INTEGRATED AUTOMATION ACTUATORS AND OPERATORS

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide complete Valve Actuators and Operators as shown on the drawings, control diagrams, herein, or in other Sections of the Specifications.

B. Hydraulic and Pneumatic actuators shall be as specified in 43 10 50.

C. Electrical Actuators shall be sized and configured to operate the 24-ink knife gate valves specified in 43 10 50.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Valve Actuators and Operators shall comply with the requirements of NEC, NEMA, and shall be built to UL-508 standards, or equal as approved by the Municipality of Anchorage Building Department.

1.03 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings in accordance with MASS Section 10.05 Article 5.6, and 26 05 00 – Electrical Work, General.
   1. Include schematics and layout drawings, and catalog cuts of all valve control equipment including enclosures, relays, pilot devices, terminations, and wire troughs.

PART 2 - PRODUCTS

2.01 GENERAL

A. The CONTRACTOR shall provide Electric Valve Actuators and Operators to satisfy the functional requirements in the relevant mechanical equipment and Instrumentation & Control specifications and the Electrical Schematics.

B. All Valve Actuators and Operators shall be wired under this Section.

C. Control conductors shall be provided in accordance with Section 26 05 00 – Electrical Work, General.

D. The electric actuators shall be suitable for use with 480VAC 3-phase power supply.

E. Actuators shall incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed in an IP68(7 meters – 72 Hours), NEMA 4 and NEMA 6 rated enclosure.

F. As a minimum the actuators should meet the requirements set out in EN15714-2 and ISA SP96.02.

G. The actuator shall incorporate a single integrated circuit, hard-wired logic control and infra-red interface.

H. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc. shall be carried out without the removal of any actuator covers and without mains power over an Infra-red or Bluetooth® wireless interface.
   1. Sufficient commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators.
   2. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage / authorized release. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool.
   3. Integral battery backup provided to update and maintain local LCD and remote contact indication and status. Expected battery life shall be 5 years.
   4. Actuator configured settings shall be stored in non-volatile EEPROM to maintain setting independent of the battery.
   5. Provision shall be made to disable Bluetooth® communications or only allow a Bluetooth® connection initiated by an Infra-Red command for maximum security.
   6. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

I. Manufacturer: **Rotork - IQT Pro** or equal.

2.02 Actuator Sizing

A. The actuator shall be sized to guarantee specified valve closure at the specified differential pressure and temperature, minimum 450Ft-lb torque.

B. Pulsed operation with independently adjustable “ON” and “OFF” time periods from 1-99 seconds selectable to operate over any portion of the closing or opening valve stroke.

C. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal.

D. For 90° valve types the operating time shall be 3.5 minutes from full open to 70° and 7.5 minutes to fully closed.

2.03 Environmental

A. Actuators shall be suitable for indoor and outdoor use.

B. The actuator shall be capable of functioning in an ambient temperature ranging from -33°C (22°F) to 70°C (140°F), up to 100% relative humidity.

2.04 Enclosure

A. Actuators shall be O-ring sealed, watertight to IP66/IP68 7m for 72hrs, NEMA 4, 6.

B. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed for site for cabling, the terminal compartment having the same ingress protection rating as the actuator with the terminal cover removed.

C. Enclosure must allow for temporary site storage without the need for electrical supply connection.

D. All external fasteners shall be plated stainless steel. The use of un-plated stainless steel or steel fasteners is not permitted.

2.05 Motor

A. The motor shall an integral part of the actuator, designed specifically for valve actuator applications.
   1. It shall be a low inertia high torque design, class F insulated with a class B temperature rise giving a time rating of 15 minutes at 40°C (104°F) at an average load of at least 33% of maximum valve torque.
   2. Temperature shall be limited by 2 thermostats embedded in the motor end windings and integrated into its control.

B. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gear case.

C. Protection shall be provided for the motor as follows:
   1. Stall - the motor shall be de-energized within 8 seconds in the event of a stall when attempting to unseat a jammed valve.
   2. Over temperature - thermostat will cause tripping of the motor. Auto-reset on cooling
   3. Direction – phase rotation correction.

2.06 Gearing

A. The actuator gearing shall be totally enclosed in a oil-filled gear case suitable for operation at any angle.

B. Grease lubrication is not permissible.

C. All drive gearing and components must be of metal construction and incorporate a lost-motion hammer blow feature.

D. For rising spindle valves the output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gear case for inspection or disassembled without releasing the stem thrust or taking the valve out of service.

E. For 90° operating type of valves drive gearing shall be self-locking to prevent the valve back-driving the actuator.

2.07 Hand Operation

A. A handwheel shall be provided for emergency operation, engaged when the motor is de-clutched by a lever or similar means, the drive being restored to electrical operation automatically by starting the motor.

B. The handwheel or selection lever shall not move on restoration of motor drive.

C. Provision shall be made for the Hand / Auto selection lever to be locked in both Hand and Auto positions.

D. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.

E. Clockwise operation of the handwheel shall give closing movement of the valve unless otherwise stated in the data sheet.

F. For linear valve types the actuator handwheel drive must be mechanically independent of the motor drive and should be such as to permit valve operation in a reasonable time with a manual force not exceeding 400N through stroke and 800N for seating / unseating of the valve.

2.08 Drive Interface

A. The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. The drive bush shall be positioned in a detachable base of the actuator.

B. Thrust bearings shall be sealed for life and the base shall be capable of withstanding five times the rated thrust of the actuator.

2.09 Local Controls

A. The actuator shall incorporate local controls for Open, Close and Stop and a Local/Stop/Remote mode selector switch lockable in any one of the following three positions: Local Control Only, Stop (no electrical operation), Remote Control plus Local Stop Only.

B. Local control selectors shall be non-intrusive.

C. It shall be possible to select maintained or non-maintained local control.

D. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

E. The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.

2.10 Torque and Limits

A. Torque and turns limitation to be adjustable as follows:
   1. Position setting range – multi-turn: 2.5 to 8,000 turns, with resolution to 7.5 deg. of actuator output.
   2. Position setting range – direct drive part turn actuators: 90° +/-10°, with resolution to 0.1 deg. of actuator output.
   3. Torque setting: 40% to 100% rated torque.

B. Position measurement
   1. Absolute position measurement should be incorporated within the actuator.
   2. The technology must be capable of reliably measuring position even in the case of a single fault. The design must be simple with the minimum amount of moving parts (no more than 5). Technologies such as LEDs or potentiometers for position measurement are considered unreliable and therefore not preferred.

C. Measurement of torque shall be from direct measurement of force at the output of the actuator. Methods of determining torque-using data derived from the motor such as motor speed, current, flux etc are not acceptable

D. A means for automatic “torque switch bypass” to inhibit torque off during valve unseating and “latching” to prevent torque switch hammer under maintained or repeated control signals shall be provided.

E. The electrical circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

2.11 Remote Valve Position and Status Indication

A. Four contacts shall be provided which can be selected to indicate any position of the valve;
   1. Provision shall be made for the selection of a normally closed or open contact form.
   2. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated.

B. The contacts shall be rated for 5mA to 5A, 120V AC, 30V DC.

C. As an alternative to providing valve position indication any of the four above contacts shall be selectable to signal one of the following:

1. Valve opening, closing or moving
2. Thermostat tripped, lost phase
3. Motor tripped on torque in mid travel, motor stalled
4. Remote selected
5. Actuator being operated by handwheel
6. Actuator fault

D. Provision shall be made in the design for an additional eight contacts having the same functionality.

E. A configurable monitor relay shall be provided as standard, which can be used to indicate either Availability or Fault. The relay should be a spring return type with a Normally Open / Normally Closed contact pre-wired to the terminal bung.

F. The Monitor (availability or fault) relay, being energized from the control transformer will de-energize under any one or more the following conditions:
   1. Available Mode
      a. Loss of main 24V DC power supply
      b. Actuator control selected to local or stop
      c. Motor thermostat tripped
      d. Actuator internal fault
   2. Fault Mode
      a. Loss of main 24V DC power supply
      b. Motor thermostat tripped
      c. Actuator internal fault

G. A contactless transmitter to give a 4-20mA analogue signal corresponding to valve travel and / or torque for remote indication is required. The transmitter will auto range to the set limits.

2.12 Local Position Indication

A. The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With mains power connected, the display shall be backlit to enhance contrast at all ambient light levels and shall be legible from a distance of at least 5m (16ft).

B. Red, green, and yellow LEDs corresponding to open, closed and intermediate valve positions shall be included on the actuator display when power is switched on. The yellow LED should also be fully programmable for on/off, blinker and fault indication. The digital display shall be maintained and updated during handwheel operation when mains power to the actuator is isolated.

C. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration and

graphical datalogger information. The text display shall be selectable between English and other languages such as: Spanish, German, French, and Italian. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator.

D. Datalogger graphical displays should as a minimum be able to display log and trend graphs on the local LCD for the following:
   1. Torque versus Position
   2. Number of Starts versus Position
   3. Number of starts per hour
   4. Dwell Time
   5. Average temperature

E. The main display shall be capable of indicating 4 different home-screens of the following configuration:
   1. Position and status
   2. Position and torque (analogue)
   3. Position and torque (digital)
   4. Position and demand (positioning)

F. Provision shall be made for the addition of an optional environmental cover to protect the display from high levels of UV radiation or abrasive materials.

G. The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.

2.13 Integral Starter and Transformer

A. The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation.

B. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size.

C. The controls shall be derived from incoming 480V 3 phase circuit and incorporate overload protection. It shall have the necessary tapping and be adequately rated to provide power for the following functions:
   1. Energizing of the contactor coils.
   2. 24V DC output for remote controls (maximum 5W / VA)
   3. Supply for all the internal electrical circuits.

2.14 Remote Control Facilities

A. The necessary control, wiring and terminals shall be provided integral to the actuator enclosure.

B. Open and close external interlocks shall be made available to inhibit local and remote valve opening / closing control.

C. It shall be possible to configure the interlocks to be active in remote control only.

D. Remote control signals fed from an internal 24V DCsupply and/or from an external supply between 20V and 60 VDC, to be suitable for any one or more of the following methods of control:
   1. Open, Close and Stop control.
   2. Open and Close maintained or “push to run” (inching) control.
   3. Overriding Emergency Shut-down to close (or open) valve from a normally closed or open contact.
   4. Two-wire control, energize to close (or open), de-energize to open (or close).

E. Additionally provision shall be made for a separate ‘drive enable’ input to prevent any unwanted electrical operation.

F. It shall be possible to reverse valve travel without the necessity of stopping the actuator. The motor starter shall be protected from excessive current surges during rapid travel reversal. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 2kV.

G. Provision shall be made for operation by distributed control system utilizing Modbus TCP.

2.15 Monitoring Facilities

A. Facilities shall be provided for monitoring actuator operation and availability as follows:

B. Actuator text display indication of the following status/alarms:
   1. Closed Limit, Open Limit, Moving Open, Moving Closed, Stopped
   2. Torque Trip Closing, Torque Trip Opening, Stalled
   3. ESD Active, Interlock Active
   4. Thermostat Trip, Phase Lost, 24V Supply Lost, Local Control Failure
   5. Configuration Error, Position Sensor Failure, Torque Sensor Failure
   6. Battery Low, Power Loss Inhibit

C. Integral datalogger to record and store the following operational data:
   1. Opening last /average torque against position
   2. Closing last /average torque against position
   3. Opening motor starts against position
   4. Closing motor starts against position
   5. Total open/closed operations
   6. Maximum recorded opening and closing torque values
   7. Event recorder logging operational conditions (valve, control and actuator)

D. The datalogger shall record relevant time and date information for stored data.

E. Datalogger data shall be accessed via non-intrusive Bluetooth® communication and data displayed on the local LCD.

F. Sufficient standard intrinsically safe tools shall be provided for downloading datalogger and actuator configuration files from the actuators and subsequent uploading to a PC.

G. The actuator manufacturer shall supply PC software to enable datalogger files to be viewed and analyzed.

2.16 Wiring and Termination

A. Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end. The terminals shall be embedded in a terminal block of high tracking resistance compound.

B. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal and shall be provided with a minimum of 3 threaded cable entries with provision for an additional 5 extra conduit entries.

C. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable. A durable terminal identification card showing a plan of terminals shall be provided attached to the inside of the terminal box cover indicating:
   1. Serial number
   2. External voltage values
   3. Wiring diagram number
   4. Terminal layout

D. The code card shall be suitable for the contractor to inscribe cable core identification alongside terminal numbers.

2.17 Commissioning Kit

A. Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Actuators shall be installed in accordance with in Section 26 05 00 – Electrical Work, General, and in accordance with the manufacturer's recommendations.

B. Actuators shall be protected at the Site from loss, damage, and the effects of weather. Actuators shall be stored in an indoor, dry location. Heating shall be provided in areas subject to corrosion and humidity.

C. Conduit, conductors, and terminations shall be installed in accordance with Section 26 05 00 – Electrical Work, General.

3.02 FACTORY PERFORMANCE AND TEST CERTIFICATE

A. Each actuator must be performance tested and individual test certificates shall be supplied free of charge. The test equipment should simulate a typical valve load, and the following parameters should be recorded.
   1. Current at maximum torque setting
   2. Torque at max. torque setting
   3. Flash test voltage
   4. Actuator output speed or operating time.

B. In addition, the test certificate should record details of specification such as gear ratios for both manual and automatic and second stage gearing if provided, drive closing direction, wiring diagram number.

3.03 FIELD TESTING

A. Testing, checkout, and startup services shall be performed by or under the technical direction of a local authorized factory technician.

B. Each device shall be tested for functional operation after the connection of external conductors and prior to equipment startup.

C. Deficient actuators and operators shall be corrected, to the ENGINEER'S satisfaction, at the CONTRACTOR'S expense.

END OF SECTION

SECTION 26 01 26 – ELECTRICAL TESTS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. This Section specifies the WORK necessary to test, commission, and demonstrate that the electrical WORK satisfies the criteria of these Specifications and functions as required by the Contract Documents.

B. The requirements of Section 26 05 00 – Electrical Work, General, apply to the WORK of this Section.

1.2 TESTING

A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.
   1. Lighting: Switching, including remote control, if indicated. Circuitry is in accordance with panel schedules.
   2. Power Instrumentation: Demonstrate that power monitor, power monitoring, current monitoring, and voltage monitoring is functional.
   3. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.
   4. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known and reasonable current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20 percent of phase current. Current injection is not required on circuits of 400 Amps or less.
   5. Cable Testing: 480-Volt circuits shall be tested for insulation resistance with a 1000-volt megohm meter. Testing shall be done after the 480-volt equipment is terminated. Control and signal wires shall be tested for continuity and resistance to ground.
   6. Test Ground Fault Interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.
   7. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:
      a. Visual and physical check of cables, circuit breakers, transformers and connections associated with each item of new and modified equipment.
      b. Circuit breakers with adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field-adjusted with settings labeled by a representative of the circuit breaker manufacturer. Settings shall be in accordance with a coordination study approved by the ENGINEER. Settings shall be tabulated and proven for each circuit breaker in its installed position. Test results shall be certified by the person performing the tests and be transmitted to the ENGINEER.

8. Complete ground testing of grounding electrodes per requirements prior to operating the equipment.

B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the ENGINEER and after process control devices have been adjusted as accurately as possible. It is intended that the CONTRACTOR will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.

C. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.

D. Motor operated valves shall be tested after having been phased and tested for correct motor rotation and after travel and torque limit switches have been adjusted by a representative of the valve manufacturer. Tests shall verify status indication, proper valve travel, and correct command control from local and remote devices.

E. Provide ground resistance tests on the main grounding bars in all control panels in the presence of the ENGINEER and submit results.

F. Subsystems shall be defined as individual groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, etc.

G. General: Carry out tests indicated herein for individual items of materials and equipment in other Sections.

H. Megger each complete phase wire, cable, termination, and pump motor winding to ground.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 26 05 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 25, 26 and 40, except as indicated otherwise.

C. The WORK of this Section is required for operation of electrically-driven equipment provided under specifications in other Divisions. The CONTRACTOR's attention is directed to the requirement for proper coordination of the WORK of this Section with the WORK of equipment specifications, and the WORK of instrumentation sections.

D. Concrete, excavation, backfill, and steel reinforcement required for encasement, installation, or construction of the WORK of the various sections of Division 26 is included as a part of the WORK under the respective sections, including duct banks, manholes, handholes, equipment housekeeping pads, and light pole bases.

1.2 REFERENCE STANDARDS

A. The WORK of this Section and all sections in Division 26 shall comply with the following, as applicable:

NEC (NFPA 70)	National Electrical Code
NECA 1 - 2015	Standard Practice for Good Workmanship in Electrical Contracting
NETA	International Electrical Testing Association
NEMA 250	Enclosure for Electrical Equipment (1000 Volts Maximum)

Municipality of Anchorage - Electrical Code amendments to the NEC.

B. Underwriters' Laboratories, Inc. (UL) standards shall apply to electrical equipment, materials and assemblies which shall be labeled as applicable for their listing and intended use as defined by NEC article 100.

C. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards, state building standards, and applicable local codes and regulations.

D. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 SIGNAGE

A. Local Disconnect Switches:
   1. Each local disconnect switch for motors and equipment shall be legibly marked to indicate its purpose, unless the purpose is indicated by the location and arrangement.

B. 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.

1.4 PUBLIC UTILITIES REQUIREMENTS

A. The CONTRACTOR shall contact the serving utilities and verify compliance with requirements before construction. The CONTRACTOR shall coordinate schedules and payments for work by all utilities.

B. The CONTRACTOR shall verify with the utility the exact location of each service point and type of service and pay all charges levied by the serving utilities as part of the WORK.

C. Electric Utility Service:
   1. Existing electric service is provided by Chugach Electric Association.
   2. The project requires retirement of the existing primary service and upgrade to new 480Y/277V permanent service to the pump station.
   3. The CONTRACTOR shall prepare and submit an application for service to the Electric Utility for the proposed service upgrade.
   4. Electric service shall be as indicated and comply with all requirements of the serving utility.
   5. The CONTRACTOR shall verify and provide all service conduits, fittings, grounding devices, and all service wires not provided by the serving utility.
   6. Outdoor service equipment enclosures shall be standard equipment as approved by the utility and rated NEMA Type 3R.
   7. Provide signage for service equipment as required by the utility.

1.5 PERMITS AND INSPECTION

A. All electrical permits shall be obtained and inspection fees shall be paid by the CONTRACTOR.

B. All electrical permits shall be obtained by the CONTRACTOR. The OWNER has paid for the inspection fees.

C. The CONTRACTOR shall pay all connection and turn-on service charges required by the utility company.

1.6 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6.

B. Shop Drawings: Include the following:
   1. Complete material lists stating manufacturer and brand name of each item or class of material.
   2. Shop Drawings for all grounding WORK not specifically indicated.
   3. Front, side, rear elevations, and top views with dimensional data.
   4. Location of conduit entrances and access plates.
   5. Component data.
   6. Connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers.
   7. Method of anchoring, seismic requirements, weight.
   8. Types of materials and finish.
   9. Nameplates.
   10. Temperature limitations, as applicable.
   11. Voltage requirement, phase, and current, as applicable.
   12. Front and rear access requirements.
   13. Test reports.
   14. Grounding requirements.
   15. Catalog cuts of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material. Catalog data sheets shall be stamped to indicate the project name, applicable Section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the ENGINEER's stamp.

C. Shop Drawings shall be custom prepared. Drawings or data indicating "optional" or "as required" equipment are not acceptable. Options not proposed shall be crossed out or deleted from Shop Drawings.

D. Materials and Equipment Schedules: The CONTRACTOR shall deliver to the ENGINEER within 30 days of the commencement date in the Notice to Proceed, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and other such information required to identify the items.

E. Owner's Manuals: Complete information in accordance with MASS Section 10.04, Article 4.20 Operating and Maintenance Manuals.

F. Record Drawings: The CONTRACTOR shall show invert and top elevations and routing of all duct banks and concealed below-grade electrical installations. Record Drawings shall be prepared, be available to the ENGINEER, and be submitted according to MASS Section 10.05 Article 5.6.

G. Equipment Summary Sheets: The CONTRACTOR shall provide Electrical Equipment Summary Form 1302 CM 1207 for all electrical devices, panels, motor starters, and miscellaneous equipment. The data shall be provided in electronic format, **Microsoft Excel**, or approved equal.

1.7 DELEGATED DESIGN SUBMITTALS

A. Electrical System Anchors, Hangers and Supports:
   1. Include design calculations for anchors, hangers and supports except where:
      a. The component weighs 400 lb or less and has a center of mass located 4 ft or less above the adjacent floor level; or
      b. The component weighs 20 lb or less or, in the case of a distributed system, 5 lb/ft or less.
   2. Include design calculations for seismic restraints for electrical installations that are not covered by exception as specified in ASCE/SEI-7, article 13.1.4.
   3. Engage a qualified professional engineer to prepare delegated design submittals as required.
   4. See related requirements in Article 3.4 of this Section.

B. Seismic Performance: Anchors, hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

1.8 AREA DESIGNATIONS

A. General:
   1. Raceway system 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. Electrical WORK in above ground indoor facilities shall be NEMA 12 unless otherwise indicated.
   4. Electrical WORK in below ground facilities and outdoors shall be NEMA 4X unless otherwise indicated.
      a. Exception: Dry Well from the Ground Floor to the Pump Room floor level shall be a NEMA 12 area.
   5. Installations in hazardous locations shall conform to the requirements of the Class, Group, and Division indicated.

B. Material Requirements:
   1. NEMA 4X enclosures shall be stainless steel.
   2. NEMA 12 enclosures shall be steel, coated with ANSI 61 grey paint.

1.9 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.

1.10 DEMOLITION AND RELATED WORK

A. The CONTRACTOR shall perform electrical demolition WORK as indicated on the Drawings and in parts of this Specification Section. The CONTRACTOR is cautioned that demolition WORK may also be indicated on non-electrical drawings. Coordinate electrical de-energization, disconnection, and removal with all trades and the overall sequence of construction.

B. Electrical work associated with removed equipment shall include:
   1. Remove power control and signal wiring as indicated.
   2. Remove all abandoned raceways.
   3. Encased conduits shall be cut flush to the floor and be grouted.
   4. Remove remote mounted starters, disconnect switches, circuit breakers, sensors, and transmitters.
   5. Remove remote mounted status lights and switches where indicated on the Drawings, and blank off openings in existing panels with field-fabricated stainless steel plates. Plates shall be attached with stainless steel finish screws.
   6. Remove control panels, equipment sheds, and concrete bases and posts for panels and sheds.
   7. Remove pump cords.
   8. Repair adjacent construction and finishes damaged during demolition work, to match original quality, function, and finish.

C. Where new lighting and receptacles are installed, all abandoned lighting, receptacles, switches, wiring, and conduits shall be removed.

D. Raceways designated to be reused or extended shall be terminated in a new junction box. The junction box shall have a NEMA rating in accordance with the area in which it is located and shall be sized as required. Raceways not designated for re-use or abandoned shall be removed.

E. Materials and equipment not indicated to be removed and returned to the OWNER shall, upon removal, become the CONTRACTOR's property and shall be disposed of off-site.

F. Material and equipment indicated to be relocated or reused shall be removed, relocated, and reinstalled with care to prevent damage thereto.

G. Materials indicated to be returned to the OWNER shall be placed in boxes with the contents clearly marked and stored at a location on-site as directed by the ENGINEER.

H. Where existing MCCs or panelboards are indicated to have circuits removed and reconnected, the MCC shall have a new engraved phenolic nameplate worded as indicated, and the panelboard schedule shall be modified to indicate the revised circuits. Pencil or magic marker markings directly on the MCC or panelboard breaker are not permitted. MCCs shall be re-listed as required when modifications or additions are indicated.

1.11 CONSTRUCTION SEQUENCING

A. All switching, safety tagging, etc., required for process or equipment shutdown or to isolate existing equipment shall be performed by the CONTRACTOR. In no case shall the CONTRACTOR begin any work in, on, or adjacent to existing equipment without written authorization by the AWWU plant supervisor and the ENGINEER. The CONTRACTOR shall remove the lock within 4 hours upon request of AWWU, in an emergency, and if the equipment is operable.

B. The CONTRACTOR shall make all modifications or alterations to existing electrical facilities required to successfully install and integrate the new electrical equipment as indicated on the electrical drawing. Modifications to existing equipment, panels, or cabinets shall be made in a professional manner with all coatings repaired to match existing. The CONTRACTOR is responsible for ensuring all panels and equipment are UL-listed. The costs for modifications (including UL listing) to existing electrical facilities required for a complete and operating system shall be included in the CONTRACTOR's original Bid amount and no additional payment for this WORK will be authorized. Extreme caution shall be exercised by the CONTRACTOR in digging trenches in order not to damage existing underground utilities. Cost of repairs of damages caused during construction shall be the CONTRACTOR's responsibility without any additional compensation from the OWNER.

C. The CONTRACTOR is advised to visit the Site before submitting a Bid to become familiar with the WORK of this Contract. Lack of knowledge will not be accepted as a reason for granting extra compensation to perform the WORK.

D. Installation of New Equipment:
   1. The CONTRACTOR shall install and terminate the new switchboards, motor starters, control panels, wireways, cables, and instruments in accordance with the agreed schedule. The CONTRACTOR shall provide a list, daily, of the points

that are ready for service as they are connected, calibrated, and tested. The CONTRACTOR shall only connect to equipment that is new or is out of service.

2. The recommended construction sequence is as follows:
   a. Remove all demolition items and make good all surfaces before applying appropriate surface finish and paint.
   b. Install new switchboards, motor starters, SCADA panels and instruments.
   c. Install new raceways between switchboards, motor starters, instruments, and new SCADA panel.
   d. Install all new wiring as specified.
   e. Complete wiring modifications to existing equipment.
3. The ENGINEER will coordinate with the CONTRACTOR to load and commission the PLC software after the CONTRACTOR makes the wiring modifications.
4. Warranty: The warranty shall start from the date of final acceptance of the completed project, and shall extend for 1 year in accordance with MASS Division 10.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment and materials shall be new and listed by UL or other recognized qualified electrical testing agency for the intended use. Listed products shall be labeled in accordance with their listing as defined by NEC article 100.

B. 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.

C. 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.

D. On devices indicated to display dates, the year shall be displayed as 4 digits.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware:
   1. Nuts, bolts, and washers shall be stainless steel.
   2. Threaded rods for trapeze supports shall be continuous-threaded, galvanized steel, 3/8-inch diameter minimum.
   3. Strut for mounting of raceways and equipment shall be galvanized or stainless steel as required by the area classification. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion. Strut shall be as manufactured by **Unistrut, B-Line,** or equal.

4. Anchors for attaching equipment to concrete walls, floors and ceilings shall be stainless steel expansion anchors, such as **"Rawl-Bolt," "Rawl-Stud"** or **"Lok-Bolt"** as manufactured by **Rawl**; similar by **Star**, or equal. Wood plugs shall not be permitted.

2.3 ELECTRICAL IDENTIFICATION

A. Nameplates: Nameplates shall be fabricated from black-letter, white-face laminated plastic engraving stock, **Formica type ES-1**, or equal. Each shall be fastened securely, using fasteners of brass, cadmium-plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style, with no characters smaller than 1/8-inch in height.

B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be heat-shrink plastic tubing with machine printing. Lettering shall read from left to right and shall face toward the front of the panel.

2.4 FUSES

A. Where fuses are specified or furnished with engineered equipment, select fuses to provide appropriate level of short circuit and overcurrent protection for the downstream equipment, and as recommended by Section 26 05 73 – Protective Device Studies.

B. Fuse Class: Provide Class RK5 fuses for applications up to 600 A if not otherwise specified.

C. Spare Parts:
   1. Furnish two fuse pullers.
   2. Furnish three spare fuses of each Class, size, and rating installed.

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 within finished rooms as indicated. Where the Drawings do not indicate exact locations, the ENGINEER shall determine such locations. If equipment is installed without instruction and must be moved, it shall be moved without additional cost to the OWNER. Lighting fixture locations shall be adjusted slightly to avoid obstructions and to minimize shadows.
3. Wherever raceways and wiring for lighting and receptacles are not indicated, it shall be the CONTRACTOR's responsibility to provide all lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations as indicated. Wiring shall be #12 AWG minimum, and conduits shall be 3/4-inch minimum. Where circuits are combined in the same raceway, the CONTRACTOR shall derate conductor ampacities in accordance with NEC requirements.
4. Where complete raceway systems are not shown on the plans, Contractor shall submit a raceway plan for approval. Intent is to minimize number of raceway systems.

C. MOA NEC Local Amendments: The CONTRACTOR shall comply with all requirements of the MOA NEC local amendments.
   1. The CONTRACTOR shall pay particular attention to the additional grounding requirements. In general, grounding conductors are not specifically called out on the drawings but are required for every raceway.

D. Workmanship:
   1. Materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer, and in compliance with NECA 1 as a minimum. Installation shall be accomplished by workers skilled in the work.
   2. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
   3. Coordinate installation and arrangement of all work with other trades to avoid interferences, and to facilitate access for future maintenance, repair and replacement without removal of adjacent work.

E. 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.

F. Incoming utility power equipment shall be provided in conformance with the utility's requirements.

3.2 CORE DRILLING

A. The CONTRACTOR shall perform core drilling required for installation of raceways through concrete walls and floors. Locations of floor penetrations, as may be required, shall be based on field conditions. Verify all exact core drilling locations based on equipment actually furnished, as well as exact field placement. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the OWNER prior to any core drilling activities. Damage to any encased conduits, wiring, and piping shall be repaired as part of the WORK.

B. All penetrations required to extend raceways through concrete walls, roofs, and floors or masonry walls shall be core drilled.

3.3 CONCRETE HOUSEKEEPING PADS

A. Concrete housekeeping pads shall be provided for indoor 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. Concrete housekeeping curbs shall be provided for all conduit stub-ups in indoor locations that are not concealed by equipment enclosures. Such curbing shall be 3 inches above finished floor or grade.

3.4 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. Such recommendations shall be submitted as Shop Drawings under MASS Section 10.05 Article 5.6.

C. Panels, raceways, and other equipment shall be anchored and supported in compliance with seismic requirements of MOA Building Safety.

3.5 EQUIPMENT IDENTIFICATION

A. General: Equipment and devices shall be identified as follows:
   1. Unless otherwise indicated, size equipment labels as follows:
      a. For major electrical equipment, power supplies, power distribution and control equipment, provide single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
      b. For individual switches and control stations, use ¼-inch high letters.
   2. 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.
   3. Control devices within enclosures shall be identified as indicated. Identification shall be similar to the subparagraph above.
   4. Equipment names and tag numbers, where indicated on the Drawings, shall be utilized on all nameplates.
   5. The CONTRACTOR shall furnish typewritten circuit directories for panelboards; circuit directory shall accurately reflect the equipment connected to each circuit.
   6. Generator power inlet facilities shall be identified with the incoming service voltage with 1" lettering.
   7. Generator transfer switches shall be labeled "Main" and "Generator" with ½" lettering.
   8. Fuses shall be installed with label oriented so make, model, and rating can be easily read.

3.6 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.

3.7 CONTROL PANEL WIRING

A. The CONTRACTOR shall ensure all panels are UL-listed upon completion of the WORK.

3.8 WIRING CONNECTIONS

A. Make final electrical connections to equipment, with wiring in conduit or provide receptacle outlet where the equipment requires connection with attachment plug. Install cord and cap for field-supplied attachment plug.

B. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment terminal boxes.

C. Install disconnect switches, controllers, control stations, and control devices with interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

D. Install terminal block jumpers to complete equipment wiring requirements.

END OF SECTION

SECTION 26 05 05 – ELECTRIC MOTORS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall provide electric motors, accessories, and appurtenances complete and operable, in conformance with the specifications and the Contract Documents.

B. The provisions of this Section apply to constant torque AC squirrel cage induction motors throughout the Contract Documents, except as indicated otherwise.

C. The CONTRACTOR shall assign to the equipment supplier the responsibility to select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the ENGINEER. Such review will consider future availability of replacement parts and compatibility with driven equipment.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6.

B. Complete motor data shall be submitted. Motor data shall include:
1. Motor manufacturer.
2. Motor type or model and dimension drawing. Include motor weight.
3. Nominal horsepower.
4. NEMA design.
5. Enclosure.
6. Frame size.
7. Winding insulation class and temperature rise class.
8. Voltage, phase, and frequency ratings.
9. Service factor.
10. Full load current at rated horsepower for application voltage.
11. Full load speed.
12. Torque characteristics.
13. Guaranteed minimum full load efficiency. Also nominal efficiencies at 1/2 and 3/4 load.
14. Type of thermal protection or overtemperature protection, if required when operated with VFD.
15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable.
16. Bearing data. Include recommendation for lubricants of relubricatable type bearings.
17. Power factor at 1/2, 3/4 and full load.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

A. General: Electric motors shall comply with NEMA MG-1 - Motor and Generator.

B. NEMA Design: Electric motors shall be NEMA Design B unless otherwise indicated. In no case shall starting torque or breakdown torque be less than the value in NEMA MG 1. Motors shall be suitable for the indicated starting method.

C. Insulation: Three phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in NEMA MG 1-12.44. Motors shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dt as defined in NEMA MG 1-31.

D. Motors shall be totally enclosed, fan-cooled (TEFC) with a Service Factor of 1.15, unless otherwise indicated.

2.2 ACCESSORY REQUIREMENTS

A. General: Motors shall have split-type cast metal conduit boxes.

B. Lifting Devices: Motors weighing 265 lb (120 Kg) or more shall have suitable lifting eyes for installation and removal.

C. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

D. Nameplate: Motors shall be fitted with permanent stainless steel nameplates indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40.

2.3 MOTOR THERMAL PROTECTION

A. Thermostats: Winding thermostats shall be snap action, bi-metallic, temperature-actuated switch. Thermostats shall be provided with one normally closed contact for each phase. The thermostat switch point shall be precalibrated by the manufacturer.

2.4 MOTOR BEARINGS

A. Motors shall have bearings designed for 100,000 hours (coupled) L-10 life.

B. Motors that are indirectly coupled and are controlled by VFD’s shall have provisions to limit bearing currents.

2.5 MANUFACTURERS

A. **U.S. Motors, Reliance Electric,** or equal,

PART 3 - EXECUTION

3.1 INSTALLATION

A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.

B. Motors shall be installed as required by the existing field conditions, including coupling and shims.

C. Related electrical WORK involving connections, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 26.

3.2 FIELD TESTING

A. The CONTRACTOR shall perform the following field tests:
   1. Inspect each motor installation for any deviation from rated voltage, phase, frequency, and improper installation.
   2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.
   3. Check winding and bearing temperature detectors and space heaters for functional operation.
   4. Test for proper rotation prior to connection to the driven equipment.
   5. Test insulation (megger test) of new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION 26 05 05

SECTION 26 05 19 – WIRE AND CABLES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide wires and cable, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6, and 26 05 00 – Electrical Work, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. Conductors, include grounding conductors, shall be copper. Aluminum conductor wire and cable will not be permitted. Insulation shall bear the label of Underwriters' Laboratories, Inc. (UL), the manufacturer's trademark, and identify the type, voltage, and conductor size. All conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment, such as motors and controllers, shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.

2.2 LOW VOLTAGE WIRE AND CABLE

A. Power and Lighting Wire
   1. Power and lighting wire shall be No. 12 copper AWG minimum size.
   2. Wire rated for 600 volts in duct or conduit for all power applications shall be:
      a. Branch circuits:
         1) Above grade interior heated locations: Class B Type THWN-2.
         2) Underground, below grade, and unheated locations: Type XHHW-2.
      b. Feeders: Type XHHW-2.
      c. Direct burial shall use XLPE outer jacketed cable.
   3. Wiring for 600 volt class power and lighting shall be as manufactured by **General Cable**, **Okonite**, or **Rome Cable**.

B. Control Wire
   1. Control wire in duct or conduit shall be the same type as power and lighting wire indicated above.
   2. Control wiring shall be No.14 19-strand copper AWG.

C. Tray Cable:
   1. Where cable tray installation is indicated for power feeders, cable and conductors shall be Type TC or Type TC-ER.

D. Submersible Pump Power Cable:
   Submersible pumps shall be wired with submersible multi-conductor cable as required by the Drawings and/or the approved Shop Drawing submittals. The cable shall be Type W Portable Power Cable rated at 600V and 70C temperature with (2) #14 control cables. The insulation shall be EPR, and conductors shall be rope-lay-stranded copper per UL-62. The cabling shall be round with round or flat fillers as needed, with an extra-hard usage, oil resistant, thermoset, CPE jacket, per UL-1581. Cable shall be Flygt SubCab, or equal.

E. VFD motor branch cable: Motors controlled by VFDs shall be wired with cables meeting the following requirements: three conductor, stranded, heat and moisture resistant cross-linked polyethylene, cabled with three (3) bare copper ground conductors. Cable core covered with 5-mil helical copper tape shield, and overall flame and sunlight resistant black jacket. Suitable for use in Class I, Division 2 locations. UL Listed. VFD motor branch cable shall be ServiceDrive Plus ASD/VFD Shielded Drive Cable or approved equal.

F. Instrumentation Cable
   1. Instrumentation cable shall be rated at 600 volts.
   2. Individual conductors shall be No. 18 AWG stranded, tinned copper. Insulation shall be color-coded polyethylene: black-red for two-conductor cable, and black-red-white for three-conductor cable.
   3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 18 AWG stranded, tinned copper drain wire, and a PVC outer jacket with a thickness of 0.048-inches.
   4. Single pair, No. 18 AWG, twisted, shielded cable shall be **Belden Part No. 9341**, or equal.
   5. Single triad, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 1119A**, or equal.

G. Unshielded Twisted Pair (UTP) Telecommunications Cable
   1. All UTP telecommunications cables that stay within the building envelope shall be UL-listed, plenum-rated CL2P, Category 6, 4-pair, 23-24 AWG, solid copper conductor, blue jacket. Superior Essex “DataGAIN” CMP or approved equal.
   2. Patch cables shall be rated to TIA/EIA 568-B.
   3. Provide RJ-45 connectors as required.

H. Radio Cable: Feedline cable for radios shall be a 50 ohm low loss 5/8” Heliax cable (less than 1.9 db per 100 feet) type suited for 900 MHz and rated for outdoor use with foam core. Provide type N connectors on each end of cable and provide a TNC to type N connector converter for each radio end. Cable shall be **Andrew LDF4.50A**, or equal.
   1. Coaxial radio jumper cable inside the SCADA panel shall be **Times Microwave LMR-240**, or equal.

I. DeviceNet Cable: Shall be 600-volt rated sunlight resistant, 65% braid coverage**,** UL Listed**, Allen-Bradley DeviceNet Trunk Cable, Type TC**, or equal.

2.3 CABLE TERMINATIONS

A. Compression connectors shall be **Burndy "Hi Lug", Thomas & Betts "Sta-Kon,"** or equal. Threaded connectors shall be split bolt type of high strength copper alloy. Pressure type, twist-on connectors will not be acceptable.

B. Pre-insulated fork tongue lugs shall be **Thomas & Betts, Burndy**, or equal.

C. General purpose insulating tape shall be **Scotch No. 33, Plymouth "Slip-knot,"** or equal. High temperature tape shall be polyvinyl as manufactured by **Plymouth, 3M**, or equal.

D. Labels for coding 600-volt wiring shall be heat-shrink plastic tubing type with machine print. Lettering shall read from left to right and face the front of the panel. Field wires terminating at a Control Panel shall be labeled with the wire number shown on the LCP Panel wiring diagrams. The CONTRACTOR shall mark all as-built drawings with wire labels.

E. See Section 25 14 05 – Local Control Stations and Miscellaneous Electrical Devices, paragraph 2.4, for a list of pump types.

2.4 CABLE SHIELDING PRODUCTS

A. EMI Cable Shielding Wrap: Field-applied flexible wrap-on cable shielding assembly with grounding provision that provides 360-degree electromagnetic interference (EMI) and radio-frequency interference (RFI) shielded protection of contained conductors.
   1. Shielding effectiveness: Third-party EMI laboratory tested per MIL-DTL-83528H (modified) or ASTM D4935 standard.
      a. 55 dB minimum over 100 kHz to 10 MHz range.
      b. 65 dB minimum over 10 MHz to 10 GHz range.
   2. Operating temperature: -54C to 121C (-65F to 250F). Compatible for use with 90C (194F) insulated conductors.
   3. Shielding material: copper, nickel-plated copper, or stainless-steel mesh.
   4. Grounding provisions: Continuous woven 15 AWG grounding braid drain wire to permit shield grounding at ends.
   5. Jacket material: Abrasion-resistant flame-retardant woven fabric jacketing, non-PVC material, per UL-510 or UL-94 standard.
   6. Jacket closure: Zipper, adhesive, Velcro, or comparable continuous method of continuous, re-enterable jacket closure.

PART 3 - EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall provide and terminate all power, control, and instrumentation conductors, except where indicated.

3.2 INSTALLATION

A. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

B. Conductors for branch circuits as defined in Article 100 of the NEC, shall be sized to prevent a voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

C. Conductors shall not be pulled into raceway until raceway has been cleared of moisture and debris.

D. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL-approved.

E. The following wiring shall be run in separate raceways:
   1. 24 VDC discrete signal and instrument power supply.
   2. 4-20 mA analog signal.
   3. All AC circuits.

F. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps and shall be fanned out to terminals.

G. Provide strain relief cord grips for cables entering enclosures or boxes.

3.3 SPLICES AND TERMINATIONS

A. General
   1. Wire taps and splices are not to be used unless the CONTRACTOR can convince the ENGINEER that they are essential and the ENGINEER gives written permission.
   2. There shall be no cable splices in underground manholes or pullboxes.
   3. Stranded conductors shall be terminated directly on equipment box lugs, making sure that all conductor strands are confined within the lug. Use forked-tongue lugs where equipment box lugs have not been provided.

4. Excess control and instrumentation wire shall be properly taped and terminated as spares.

B. Control Wire and Cable
   1. Control conductors shall be spliced or terminated only on terminal strips in panels or vendor-furnished equipment.
   2. In terminal cabinets, junction boxes, motor control centers, and control panels, control wire and spare wire shall be terminated to terminal strips.

C. Instrumentation Wire and Cable
   1. Shielded instrumentation cables shall be grounded at one end only, the receiving end (i.e., in the SCADA panel) on a 4-20 mA system.

D. Power Wire and Cable
   1. No 120/208-volt, 120/240-volt, and 480/277-volt branch circuit conductors may be spliced unless the CONTRACTOR can convince the ENGINEER that they are essential and the ENGINEER gives written permission.
   2. Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable and terminal manufacturer. The CONTRACTOR shall submit the proposed termination procedure as a Shop Drawing.
   3. VFD motor circuits shall be shielded cable assemblies or shielded by metallic conduit. Where VFD circuit conductors are unshielded in a common raceway or enclosure with other circuits, provide approved field-applied shielding to each circuit as required to effectively attenuate and isolate EMI / RFI from VFD circuits in proximity to other circuits.

3.4 CABLE IDENTIFICATION

A. General: Wires and cables shall be identified for proper control of circuits and equipment and to reduce maintenance effort.

B. Identification Numbers: The CONTRACTOR shall assign to each control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to all conductors having common terminals and shall be shown on "as built" drawings. Identification numbers shall appear within 3 inches of conductor terminals. "Control Conductor" shall be defined as any conductor used for alarm, annunciator, or signal purposes.
   1. Multiconductor cable:
      a. Assign a number that shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath freestanding equipment.
      b. Cable number shall form a part of the individual wire number.
      c. Individual control conductors and instrumentation cable shall be identified at pull points as described above.
      d. The instrumentation cable numbers shall incorporate the loop numbers assigned in the Contract Documents.
   2. All 120/208-volt system feeder cables and branch circuit conductors shall be color-coded as follows:
      a. Phase A - Black

b. Phase B - Red
c. Phase C - Blue
d. Neutral - White

3. The 120/240-volt system conductors shall be color-coded as follows:
   a. Line 1 - Black
   b. Line 2 - Red
   c. Neutral - White
4. The 480/277-volt system conductors shall be color-coded as follows:
   a. Phase A - Brown
   b. Phase B - Orange
   c. Phase C - Yellow
   d. Neutral - Gray
5. Color-coding tape shall be used where colored insulation is not available.
   a. Branch circuit switch shall be Yellow.
   b. Insulated ground wire shall be Green.
   c. Neutral shall be Gray.
6. Color coding and phasing shall be consistent throughout the Site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.
7. General purpose AC control cables shall be Red.
8. General purpose DC control cables shall be Blue.
9. Spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
10. Terminal strips shall be identified by computer-printable, cloth, self-sticking marker strips attached under the terminal strip.

3.5 TESTING

A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-68-516 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. Factory test results shall be submitted in accordance with Section 01300 – Contractor Submittals, prior to shipment of cable. The following field tests shall be the minimum requirements:
   1. Power cable rated at 600 volts shall be tested for insulation resistance between phases and from each phase to ground using a megohmmeter with a minimum 1000VDC test voltage.
   2. Field testing shall be done after cables are installed in the raceways.
   3. Field tests shall be performed by a certified test organization acceptable to the cable manufacturer. Test results shall be submitted to the ENGINEER for review and acceptance.
   4. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

B. Continuity Test: Control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing all wires and cables in service.

END OF SECTION

SECTION 26 05 26 – GROUNDING

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide the electrical grounding system, complete and operable, in accordance with the Contract Documents. The existing ground electrode system shall be tested and improved as required to comply with NEC requirements and these specifications.

B. The requirements of Section 26 05 00 – Electrical Work, General apply to this Section.

C. Single Manufacturer: Like products shall be the product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6 and Section 26 05 00 – Electrical Work, General.

B. Shop Drawings: Manufacturer's product information for connections, clamps, and grounding system components, showing compliance with the requirements of this Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Components of the grounding electrode system shall be manufactured in accordance with ANSI/UL 467 - Standard for Safety Grounding and Bonding Equipment, and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

2.2 GROUNDING SYSTEM

A. Horizontal grounding electrode conductors shall be bare annealed copper conductors suitable for direct burial. Conductors shall be No.4/0, unless indicated otherwise.

B. Ground Rods

1. Unless indicated otherwise, the ground rod shall be a minimum of 3/4-inch in diameter, 10 feet long, and have a uniform covering of electrolytic copper metallically bonded to a rigid steel core. The copper to steel bond shall be corrosion resistant.
2. Conform to ANSI/UL 467.
3. Sectional type joined by threaded copper alloy couplings.

C. Exothermic Connections: Buried cable-to-cable and cable-to-ground rod connections shall be made using exothermic welds by **Cadweld, Erico Products**, or equal.

D. Compression Connectors: Exposed grounding connectors shall be of the compression type (connector to cable), made of high copper alloy, and be manufactured specifically for the particular grounding application. The connectors shall be **Burndy, O.Z. Gedney**, or equal.

E. Grounding clamps shall be used to bond each separately derived system to the grounding electrode conductors.

F. Equipment Grounding Circuit Conductors
1. These conductors shall be the same type and insulation as the load circuit conductors. The minimum size shall be as outlined in Table 250.122 of the National Electrical Code, unless indicated otherwise.
2. Metallic conduit systems shall have equipment grounding wires as well as being equipment grounding conductors themselves.

G. Ground clamps in concrete shall be rated for use with rebar and embedded in concrete.

H. Manufacturers of grounding materials shall be **Copperweld, Blackburn, Burndy**, or equal.

PART 3 - EXECUTION

3.1 GROUNDING

A. Provide a separate grounding conductor, securely grounded in each raceway independent of raceway material.

B. Provide a separate grounding conductor for each motor and connect at motor box. Do not use bolts securing motor box to frame or cover for grounding connectors.

C. Size in accordance with the NEC-Article 250 and local amendments.

D. Route conductors inside raceway.

E. Provide a grounding type bushing for secondary feeder conduits which originate from the secondary section of each MCC section, switchboard, or panelboard.

F. Provide grounding bushings for all conduits entering non-metallic enclosures and boxes. Bond all together and to the assembly ground bus.

G. Individually bond these raceways to the ground bus in the secondary section.

H. Provide a green insulated wire as grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

I. Provide a separate grounding conductor in each individual raceway for parallel feeders.

J. Bond the neutral bus to the ground bus only at the service entrance point or for separately derived systems such as transformers.

K. Bond cold water pipe systems and metallic building structure per NEC. Bond ALL metallic pipe penetration

L. Provide exothermic weld connections for buried grounding connections.

M. Low Voltage Grounded System (600-volt or less): A low voltage grounded system is a system where the local power supply is a transformer with the transformer secondary grounded.

1. Grounding system connections for a premises wired system supplied by a grounded AC service shall have a grounding electrode connector connected to the grounded service conductor at each service, in accordance with the NEC.
2. The grounded circuit conductor shall not be used for grounding non-current carrying parts of equipment, raceways, and other enclosures except where specifically listed and permitted by the NEC.

N. Embedded Ground Connections

1. Underground and grounding connections embedded in concrete shall be UL listed compression type ground grid connectors.
2. The connection shall be made in accordance with the manufacturer's instructions.
3. The CONTRACTOR shall not conceal or cover any ground connections until the ENGINEER or authorized representative has established that every grounding connection conforms to the Contract Documents and has given the CONTRACTOR written confirmation.

O. Ground Rods

1. Locations shall be as determined in the field.
2. Rods forming an individual ground array shall be equal in length.

3. Rod spacing shall be a minimum of the rod length.

P. Shield Grounding

1. Shielded instrumentation cable shall have its shield grounded at one end only unless Shop Drawings indicate the shield will be grounded at both ends.
2. The grounding point shall be at the control panel or otherwise at the receiving end of the signal carried by the cable.
3. Termination of shield drain wire shall be on its own terminal screw.
4. Terminal screws shall be jumpered together using manufactured terminal block jumpers.
5. Connection to the ground bus shall be via a green No. 12 conductor to the main ground bus for the panel.

3.2 TESTS

A. Measure ground impedance for the grounding electrode system in accordance with IEEE STD 81 after installation, but before connecting the electrode system to the remaining grounding system.

1. Acceptable AC power system earth grounding resistance: 5 ohms maximum.

END OF SECTION

SECTION 26 05 33 – ELECTRICAL RACEWAY SYSTEMS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide electrical raceway systems, complete and in place, in accordance with the Contract Documents.

B. Local amendments to NEC require:
   1. The equipment grounding conductor run with or enclosing the circuit conductors shall be one or more or a combination of the following:
      a. A copper, aluminum, or copper-clad aluminum conductor.
      b. This conductor shall be solid or stranded; insulated, covered, or bare; and in the form of a wire or a bus bar of any shape.

1.2 DEFINITIONS

A. Raceway System – raceway system consists of conduits, wireways, fittings, junction and pull boxes, supports, labels complete and ready for conductors.

PART 2 - PRODUCTS

2.1 GENERAL

A. Conduits, wireways, fittings, supports, labels, junction and pull boxes, and other indicated enclosures which are dedicated to the raceway system, shall comply with the requirements of this Section.

2.2 CONDUIT

A. Galvanized Rigid Steel Conduit (GRC)
   1. Rigid steel conduit shall be mild steel, hot-dip galvanized inside and out.
   2. Rigid steel conduit shall be manufactured in accordance with ANSI C80.1 - Rigid Steel Conduit, Zinc Coated, and UL-6.
   3. Manufacturers, or Equal
      a. **LTV Steel**;
      b. **Triangle**;
      c. **Wheatland Tube**.
   4. GRC shall be used in all locations except outdoor locations, NEMA-4X locations, or where PVC-coated GRC is otherwise specified.

B. PVC-Coated Galvanized Rigid Steel Conduit (PVC-coated GRC)

1. The conduit, prior to PVC coating, shall meet the requirements for GRC conduit above.
2. A PVC coating shall be bonded to the outer surface of the galvanized conduit. The bond between the coating and the conduit surface shall be greater than the tensile strength of the coating.
3. PVC coating thickness shall be not less than 40 mils.
4. PVC-coated GRC shall be manufactured in accordance with the following standards:
    a. UL-6
    b. ANSI C80.1
    c. NEMA RN1 - PVC Externally Coated Galvanized Rigid Steel Conduit, Intermediate Metal Conduit, and where shown on the plans
5. Manufacturers, or Equal
    a. **Robroy**;
    b. **Ocal**.
6. PVC-coated GRC shall be used in all direct-bury installations, outdoor locations, NEMA 4X designated areas, and where shown on the drawings.

C. Liquidtight Flexible Conduit (LFMC)
1. Liquidtight flexible conduit (LFMC) shall be constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket.
2. LFMC shall be manufactured in accordance with UL-360 - Steel Conduits, Liquid-Tight Flexible.
3. Manufacturers, or Equal
    a. **Anaconda, "Sealtite"**;
    b. **Electriflex, "Liquatite"**.

D. Flexible Explosionproof Conduit:
1. Flexible explosionproof conduit shall be manufactured from braided steel or copper alloy with inner insulating liner.
2. Fittings shall be threaded.
3. Flexible explosionproof conduit shall be 1/2-inch trade size or larger and shall be manufactured by Crouse-Hinds "Series EC," Killark "Series EKJ," or equal.

E. Electrical Metallic Tubing (EMT) or Intermediate conduit (IMC) will not be accepted.

2.3 FITTINGS AND BOXES

A. General:
1. Fittings and boxes shall follow the conduit type of which they are installed with: PVC-Coated Fittings and Boxes or stainless steel boxes shall be used with PVC-Coated GRC; galvanized malleable iron Fittings and Boxes shall be used with GRC.
2. Cast and malleable iron fittings for use with metallic conduit shall be the threaded type with 5 full threads.

3. Fittings and boxes shall have neoprene gaskets and non-magnetic stainless steel screws. All covers shall be attached by means of holes tapped into the body of the fitting. Covers for fittings attached by means of clips or clamps will not be acceptable.
4. Non-explosion-proof boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.
5. Boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.
6. In outdoor areas, raceways shall be terminated in raintight hubs as manufactured by **Myers, O.Z. Gedney**, or equal. In other than outdoor areas, sealed locknuts and bushings shall be used.
7. Fittings and boxes in hazardous locations shall be suitable for the Class and Division indicated or required by code.

B. Cast Aluminum Fittings and Boxes
1. Cast aluminum boxes and fittings shall have less than 0.40 percent copper content.
2. Manufacturers, or Equal
   a. **O.Z. Gedney**;
   b. **Appleton**;
   c. **Crouse-Hinds**.

C. Malleable Iron Fittings and Boxes
1. Fittings and boxes for use with galvanized steel conduit shall be of malleable iron or gray-iron alloy with zinc plating.
2. Manufacturers, or Equal
   a. **O.Z. Gedney**;
   b. **Crouse-Hinds**;
   c. **Appleton**.

D. PVC-Coated Fittings and Boxes
1. Fittings and boxes for use with PVC-coated GRC shall be PVC-coated and shall be products of the same manufacturer as the conduit.
2. Fittings used for LFMC and PVC-coated systems are to be PVC-coated.

E. Stainless Steel Boxes
1. Stainless steel boxes shall be used with PVC-coated GRC raceway systems and where indicated on the Drawings.
2. Stainless steel boxes shall be NEMA 4X, Type 304.
3. Stainless steel shall be a minimum 14-gauge thickness, with a brushed finish.
4. Doors shall have full-length stainless steel piano hinges. Non-hinged boxes are not acceptable.
5. Manufacturers, or Equal
   a. **Hoffman**;
   b. **Rohn**;
   c. **Hammond**.

2.4 WIREWAYS

A. All wireways shall be painted ANSI 61 gray, galvanized 14-gauge steel with screw covers and a steel divider to separate the discrete signals from the analog signals. Wireways shall be **Hoffman**, or equal.

B. Wireway shall be NEMA 12 and used only in above ground indoor locations.

C. Wireway systems not shown on the plans shall be submitted for approval.

2.5 CABLE TRAYS

A. Refer to Section 26 05 36.

2.6 IDENTIFICATION TAPE

A. Continuous lengths of warning tapes shall be installed 12 inches above and parallel to all underground conduits. Tape shall be 6-inch-wide polyethylene film imprinted, “CAUTION – ELECTRIC UTILITIES BELOW.” Tape shall be as manufactured by **Brady**, or equal.

2.7 EXPLOSION-PROOF BOXES

A. Explosion-proof boxes shall be used to house control stations, switches, any arc producing device, and terminal for splicing in hazardous locations. The boxes shall be made from copper-free aluminum with stainless steel hardware, have a hinged cover, and use O-ring gaskets for watertight integrity. The boxes shall be factory painted with epoxy gray paint. Boxes 12” x 12” and larger shall have (1) 2” hole and (2) 1.5” holes, and (2) 1” holes drilled, tapped, and plugged on the bottom of the box. The boxes shall be **Appleton Electric AJBEW**, or equal.

2.8 EXPLOSION-PROOF CONDUIT FITTINGS AND UNIONS

A. Explosion-proof conduit fittings and unions shall be made from zinc electroplated malleable iron. Fittings shall include gasketed water-tight connections, be UL-listed for use in Class 1 Division 1 areas. Fittings shall be **Appleton Electric**, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All wiring shall be run in raceway unless indicated otherwise.

B. Raceways shall be installed between equipment as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical and shall be accomplished with

tools designed for this purpose. Field bends are required on conduits up to 2". Factory elbows may be utilized on raceways over 2". All fittings and connections shall be made tight.

C. Separate raceway systems shall be provided for:
   1. Analog signals
   2. 24 VDC discrete signals and instrument power supply conductors
   3. 120 VAC and higher wiring
   4. Intrinsically safe wiring

   When non-loop powered instruments have only one raceway port, the CONTRACTOR may run both the analog and 24 VDC wiring in a short length of ½" LFMC (or as shown) to a splitter box where the wiring must then be separated into the required raceway system. The length of LFMC must be kept to the absolute minimum and must not exceed 3 feet unless written approval has been given by the ENGINEER.

D. Mixed source conductors permitted to be grouped in wireways shall be bundled separately and secured to the walls of the wire way keeping a minimum of 2" separation between circuit types.

E. Where raceway routings are indicated on plan views, follow those routings to the extent possible. See SECTION 26 05 00 – ELECTRICAL WORK, GENERAL Article 3.1 Para B for additional installation requirements.

F. Routings shall be adjusted to avoid obstructions. Coordinate between trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation, and removal and re-installation to resolve conflicts shall be by the CONTRACTOR as part of the WORK.

G. Support rod attachment for ceiling-hung trapeze installations shall meet the seismic requirements.

H. Exposed raceways shall be installed parallel or perpendicular to structural beams.

I. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.

J. Exposed raceways shall be installed at least 1/2-inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, exposed raceways shall be installed 1/4-inch minimum from the face of walls or ceilings by the use of clamp backs or struts.

K. In underground facilities or NEMA 4X areas, all raceway penetrations in panels shall be bottom entry.

L. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, suitable insulating means shall be provided to prevent such corrosion.

M. To facilitate future expansion, boxes and fittings are to be installed when indicated on the drawings. Unused hubs are to be plugged with proprietary devices. Raceways that include future expansion provision are to be sized to accommodate any such specified wiring without exceeding the requirements of this specification.

N. The maximum allowable conduit fill for instrumentation and control wiring is given by the following table:

Conduit Diameter	No. of 14-Gauge Wires	No. of 18-Gauge TWS
3/4”	8	2
1”	16	4
1-1/4”	32	7
1-1/2”	48	10
2”	72	17

Note: No instrumentation or control wiring conduit is to be larger than 2 inches in diameter.

3.2 RACEWAYS

A. Exposed raceway systems shall be rigid galvanized steel except as follows, unless indicated otherwise:
   1. In outdoor areas, underground vaults, and NEMA 4X areas, use PVC-coated GRC.
   2. In Actuator Room and Wet Well Fan Room, use PVC-coated GRC.

B. Raceways concealed, buried, or encased in concrete, shall be PVC-coated GRC. Where conduit emerges from concrete encasement, a PVC-coated RGS elbow shall be utilized for transition from the concrete. Conduit shall emerge from the concrete perpendicular to the surface whenever possible.

C. Exposed conduit shall be 3/4-inch minimum trade size. Supports shall be installed at distances required by the NEC.

D. Conduit shall not be encased in the bottom floor slab below grade.

E. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4-inch for concrete not exposed to weather or in contact with the ground.

F. Raceways passing through a slab, wall, or beam shall not impair significantly the strength of the construction.

G. Raceways embedded within a slab, wall, or beam (other than those merely passing through) shall satisfy the following:

1. Conduits with their fittings embedded within a column shall not displace more than 4 percent of the gross area of cross section.
2. Conduits shall not be larger in outside dimension than one third the overall thickness of slab, wall, or beam in which embedded.
3. Raceways shall not be spaced closer than 3 outside diameters on centers.

H. Raceways shall be placed so that cutting, bending, or displacing reinforcement from its proper location will not be required.

I. Threads shall be coated with a conductive lubricant before assembly.

J. Joints shall be tight, thoroughly grounded, secure, and free of obstructions in the pipe. Conduit shall be adequately reamed to prevent damage to the wires and cables inside. Strap wrenches and vises shall be used to install conduit to prevent wrench marks on conduit. Conduit with wrench marks shall be replaced.

K. Wherever raceways enter substructures below grade, the raceways shall be sloped to drain water away from the structure. Extreme care shall be taken to avoid pockets or depressions in raceways.

L. Connections to lay-in type grid lighting fixtures shall be made using LFMC not exceeding 4-feet in length. Connections to motors and other equipment subject to vibration shall be made with LFMC not exceeding 3-feet in length. Equipment subject to vibration that is normally provided with wiring leads shall be provided with a cast junction box for the make-up of connections. The junction box is to be independently supported and <u>not</u> left free to hang from the equipment.

M. Raceways passing through walls or floors shall have plastic sleeves. Core drilling shall be performed in accordance with Section 26 05 00.

N. Provide raceway seal fittings at the following locations:
1. In hazardous classified locations, in strict accordance with the NEC.

O. Conduit, fittings, and boxes required in hazardous classified areas shall be suitably rated for the area and shall be provided in strict accordance with NEC requirements.

P. Empty raceways shall be tagged at both ends to indicate the final destination. Where it is not possible to tag the raceway, destination shall be identified by a durable marking on an adjacent surface. A pull-cord shall also be installed in each empty conduit. This shall apply to conduits in floors, panels, manholes, equipment, etc.

Q. Where an underground raceway enters a structure through a concrete roof or a membrane waterproofed wall or floor, core-drill the entrance and provide a Link-Seal, or equal, sealing device. The sealing device shall be utilized with rigid steel conduit.

R. Final connections to heaters, instruments, motors, limit switches, and any equipment subject to vibration shall be made with LFMC and approved fittings. Maximum length of LFMC shall be 3 feet.

S. Connections to solenoid valves, pilot actuators, and flood sensors shall be made with LFMC and approved fittings to a cast box with screw cover (GUA type), independently and securely supported. In no case is the device to support the cast box.

T. Raceways used as a chase such as at wet wells shall be provided with an inner liner in lieu of a bushing at the end of the conduit. **CROUSE HINDS** LNR or equal

3.3 CABLE TRAYS

A. Refer to Section 26 05 36.

END OF SECTION

SECTION 26 05 36 – CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide cable tray systems, complete and in place, in accordance with the Contract Documents.

B. Related Sections:

1. Section 26 05 00 - Electrical Work, General.
2. Section 26 05 26 - Grounding and Bonding for Electrical Systems

1.2 REFERENCES

A. ASTM International:

1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. National Electrical Manufacturers Association:

1. NEMA VE 1 - Metal Cable Tray Systems.
2. NEMA VE 2 - Metal Cable Tray Installation Guidelines.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6 and Section 26 05 00 – Electrical Work, General.

B. Product Data: Manufacturer's product information for cable tray, fittings, accessories, clamps, and grounding system components, showing compliance with the requirements of this Section.

C. Shop Drawings:
1. Indicate tray type, dimensions, support points, and finishes.
2. Include cable tray support details and identified on plans in accordance with Section 26 05 00 – Electrical Work, General. Seismic controls and support details for the cable tray system shall be a deferred submittal prepared under the seal of a professional structural engineer registered in the state of Alaska.

1.4 QUALIFICATIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Controls: Restrain cable trays to limit movement due to seismic forces in accordance with Section 26 05 00 00 - Electrical Work, General.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
   1. Source Limitations: Obtain cable trays and components from single manufacturer.
   2. Sizes and Configurations: See Drawings for specific requirements and configurations.
   3. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
   4. Concentrated Load: A load applied at midpoint of span and centerline of tray.
   5. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAYS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Eaton / B-Line Cable Tray or an Owner approved comparable.
   1. Configuration: Two I beam side rails with I-beam transverse rungs welded to side rails.
   2. Rung spacing: 9 inches.
   3. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
   4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.
   5. No portion of the rungs shall protrude below the bottom plane of side rails.
   6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
   7. Minimum Usable Load Depth: 3-inches, unless otherwise scheduled on plans.
   8. Straight Section Lengths: As scheduled or indicated on Drawings, and as required to facilitate assembly.
   9. Width: As scheduled on Drawings.
   10. Fitting Minimum Radius: 12 inches (300 mm) for power cable trays, unless otherwise indicated.

11. The maximum uniform load and the support span are indicated by the cable tray class.
12. Class Designation: Comply with NEMA VE 1
13. Splicing Assemblies: Bolted type using serrated flange locknuts.
14. Hardware and Fasteners: Geomet coated.

2.4 MATERIALS AND FINISHES

A. Aluminum:
   1. Materials: Alloy 6063-T6 for extruded components, and Alloy 6061-T6 for fabricated parts.
   2. Hardware: Chromium-zinc-plated steel, ASTM F 1136

2.5 CABLE TRAY ACCESSORIES

1. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
2. Covers: Where covers are indicated on Drawings, provide ventilated type made of same materials and with same finishes as cable tray for all sections.
3. Barrier Strips: Same materials and finishes as for cable tray for all tray.
4. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.6 WARNING SIGNS

A. Lettering: 1-1/2-inch (40-mm) high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

B. Comply with requirements for fasteners in Section 26 05 53 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA VE 1.

3.2 CABLE TRAY INSTALLATION

A. Install metal cable trays according to NEMA VE 2.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation, inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use rib-neck carriage bolts and locknuts.

F. Fasten cable tray supports to building structure according to approved Shop Drawings.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb (90 kg).

H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Utilize splice plates that allow full rated load at Mid Span.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Supports shall be adjusted and arranged to prevent twisting from eccentric loading.

K. Locate and install supports according to Manufacturer's instructions. Do not install more than one cable tray splice between supports.

L. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

M. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in **NEMA VE 2**. Space connectors and set gaps according to applicable standard.

N. Make changes in direction and elevation using manufacturer's recommended fittings.

O. Make cable tray connections using manufacturer's recommended fittings.

P. Install cable trays with enough workspace to permit access for installing cables.

Q. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.3 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 26 05 26 "Grounding."

B. Cable trays with electrical power conductors shall be bonded together with splice plates listed for grounding purposes.

C. Verify that cable tray system is specified for grounding and bonding the largest power conductor in the tray.

D. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch (1800-mm) intervals. If not otherwise indicated, the grounding conductor shall be sized as a minimum according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."

E. Cable trays with powder-coat paint should have coating mask completely removed at factory supplied grounding location and splice with listed connectors as recommended by manufacturer. After completing splice-to-grounding-bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

F. Bond cable trays to power source for cables contained within using bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.4 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables as required to maintain triplex or quadruplex groupings and separation, as indicated on plans.

C. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

D. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

E. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 12 inches (300 mm).

3.5 CONNECTIONS

A. Connect raceways to cable trays according to requirements in NEMA VE 2.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.

2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare written test and inspection reports.

3.7 PROTECTION

A. Protect installed cable trays and cables.
1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

3.8 WARNING SIGNS

A. Engraved Nameplates: Install ½-inch black letters on yellow laminated plastic nameplate, engraved with: WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

END OF SECTION

SECTION 26 05 73 – PROTECTIVE DEVICE STUDIES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall perform short circuit, arc-fault and protective device studies for the electrical power system in accordance with the Contract Documents.

B. The Work of this Section shall include protection studies for the following:
   1. Electrical distribution system from the normal and standby power sources down to and including the main breaker and bus for each panelboard.
   2. Motors with solid state overload and overcurrent protection devices.
   3. The typical operating arrangements of the power electrical system as shown in the table below:

CEA Electric Service	Standby Generator
X	O
O	X
Note: 1 . X – Power Supply ON; O – Power Supply OFF	

C. Provide settings for all adjustable protective devices in accordance with study recommendations. Label all electrical equipment based on results of the studies.

D. It is the responsibility of the Contractor to obtain the information required from the electric utility, equipment vendors, and existing infrastructure within the study scope limits.

1.2 QUALIFICATIONS

A. Short circuit studies, protective device evaluation studies, arc-flash hazard analysis studies, and protective device coordination studies shall be performed by a firm that has been regularly engaged in short circuit and protective device coordination services for a period of at least 15 years.

B. The indicated studies shall be signed by the professional electrical engineer, registered in the State of Alaska, responsible for the studies.

C. The studies shall utilize computer software programs with national distribution and proven reliability and accuracy for performing 3-phase fault-duty calculations in compliance with IEEE 399, and capable of:
   1. Plotting and diagramming time-current-characteristic curves as part of its output, with identification of device settings and ratings of all overcurrent protective devices.
   2. Phase to ground fault current calculations.

3. Arcing fault studies with arc-flash hazard boundary calculations.

1.3 CONTRACTOR SUBMITTALS

A. Qualifications Data: Submit the following items for review prior to starting study.
   1. Qualifications and background of firm.
   2. Qualifications of Professional Engineer performing study.
   3. Software proposed to be used in performing study.

B. Preliminary Report:
   1. An initial short circuit study and protective device coordination study shall be submitted and reviewed by the Engineer prior to approval of Shop Drawings for distribution equipment.
   2. Adequacy of the equipment "withstand" and interruption ratings shall be approved by the Engineer.

C. Final Report:
   1. Submit copies of final report signed by professional engineer. Make additions or changes required by review comments.
   2. The short circuit, arc-flash hazard analysis, and protective device coordination studies shall be updated prior to Project Substantial Completion; utilize characteristics of as-installed equipment and materials.

1.4 MANUFACTURER'S SERVICES

A. Contractor shall furnish qualified field engineering services certified by the equipment manufacturers to test, calibrate, and adjust the protective devices as recommended in the power system coordination study for power system equipment that includes:
   1. Low voltage switchboard circuit breakers.
   2. Standby generator main breakers.
   3. Influent pump VFD controllers.

PART 2 - PRODUCTS

2.1 LABELS

A. Pre-printed self-adhesive vinyl labels with clear chemical resistant coating per Article 3.6.
   1. Warning signs for arc-flash hazard boundary, with safety color coding of warning signs as required by OSHA. See 3.7 for list of parameters to display.
   2. Labels for protective device calibration and setting record.

PART 3 - EXECUTION

3.1 GENERAL

A. The studies shall include development of single-line and impedance diagrams of the power system.

B. The diagrams shall identify components considered in the study and the ratings of power devices, including transformers, circuit breakers, relays, fuses, busses, and cables.

C. The resistances and reactances of cables shall be identified in the impedance diagram.

D. The studies shall contain written data from the electric utility company regarding maximum available short circuit current, voltage, and X/R ratio of the utility power system.

E. The studies shall include every protective device and feeder included or modified within the WORK.

F. The first upstream overcurrent device outside the WORK shall be used as a fixed reference.

G. The studies shall include all portions of the electrical distribution system for normal and standby power sources down to and including the 480-volt distribution system.

3.2 SHORT CIRCUIT STUDY

A. The short circuit study shall be performed with the aid of a digital computer program, and shall be in accordance with the following Standards:

ANSI/IEEE 141	Recommended Practice for Electrical Power Distribution for Industrial Plants
ANSI/IEEE 242	Recommended Practice for Protection, and Coordination of Industrial, and Commercial Power Systems
ANSI/IEEE 399	Recommended Practice for Power Systems Analysis
ANSI/IEEE C 37.010	Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE C 37.13	Low-Voltage AC Power Circuit Breakers Used in Enclosures
NFPA 70	National Electrical Code (NEC)

3.3 PROTECTIVE DEVICE EVALUATION STUDY

A. A protective device evaluation study shall be performed in order to determine the adequacy of circuit breakers, molded case switches, and fuses.

B. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the attention of the Engineer.

C. Do not utilize series-rated circuit breakers to meet short circuit requirements for this project.

D. Devices shall be fully rated to withstand available fault currents.

3.4 PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed in order to develop the necessary calculations to select power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage breaker trip characteristics and settings.

B. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the Engineer's attention.

C. The study shall be inclusive of all distribution feeders and recommendations implemented.

3.5 TIME/CURRENT COORDINATION CURVES

A. As a minimum, the time/current coordination curves for the power distribution system shall include the following items plotted on 5-cycle log-log graph paper:
   1. time/current curves for each protective relay, circuit breaker, or fuse demonstrating graphically that the settings will provide protection and selectivity within industry standards
   2. Each curve shall be identified, and tap and time dial settings shall be specified.
   3. Provide individual curves for each feeder unless identical to others.
   4. Selectivity
      a. Time/current curves for each device shall be positioned to provide the maximum selectivity to minimize system disturbances during fault clearing.
      b. Where selectivity cannot be achieved, the Engineer shall be notified as to the cause.
      c. Recommendations shall be included for alternate methods that would improve selectivity.
   5. Time/current curves and points for cable and equipment damage.
   6. Circuit interrupting device operating and interrupting times
   7. Indicate maximum fault values on the graph.

8. Sketch of bus and breaker arrangement
9. Magnetizing inrush points of transformers
10. Thermal limits of dry-type and liquid-insulated transformers (ANSI damage curve)
11. Every restriction of the ANSI and National Electrical Code shall be followed, and proper coordination intervals and separation of characteristics curves shall be maintained.

3.6 ARC FLASH STUDY

A. An arc flash study shall be performed with the aid of a digital computer program in order to determine the “Arc Flash Protection Boundary” and “Personal Protective Equipment” (PPE) levels for applicable electrical distribution equipment, stand-alone disconnects, starters, and variable frequency drives (VFDs) in the power distribution system.

B. The arc flash study shall be performed in conjunction with short circuit calculations and protective device coordination.

C. The arc flash study shall be in accordance with the latest version of the following Standards:

NFPA 70E	Standard for Electrical Safety Requirements for Employee Workplaces
IEEE 1584	IEEE guide for performing Arc Flash Hazard Calculations
OSHA (29 CFR PART 1910)	Occupational Safety and Health Standards for General Industry
ANSI Z535.4	Product Safety Signs and Labels

D. The recommended values for the “Arc Flash Protection Boundary” and PPE levels, based on the arc flash study results, shall be tabulated in the study.

E. The Arc Flash analysis shall include calculations for maximum and minimum contributions of the fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minium and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

F. Arc Flash computation shall include both line and load side of main breaker calculations, where necessary.

G. Arc Flash calculations shall be performed for each generator supplying power and utility supplying power.

H. Safety and Arc Flash Placards

1. The digital computer program shall provide the “Arc Flash Protection Boundary” and PPE values in a format that can be directly printed on to labels for the worst case result.
2. OSHA compliant labeling shall be included on all electrical panels, equipment, and applicable raceways. This includes:
    a. high voltage warning,
    b. arc flash hazard rating,
    c. system voltage,
    d. maximum fault current,
    e. series combination rating,
    f. amps interrupting rating (AIC),
    g. clearance requirement warning,
    h. turn off power prior to working inside equipment,
    i. label for conductor color coding,
    j. label to identify power source,
    k. other OSHA/NEC required labeling depending on installation.
3. The Contractor shall provide (furnish and post in the field) these labels in accordance with Section 26 05 00 – Electrical Work, General and Article 2.1.
4. The Contractor shall merge the arc flash results and provide a complete list for a worst case value for each bus.

3.7 STUDY RESULTS

A. Summarize the results of the indicated power system studies in report format, to include:
    1. Description of computer program used, purpose, basis, procedures, and scope of study.
    2. Single-line diagram
    3. Impedance diagram
    4. Tabulation of all protective devices identified on the single line diagram
    5. Characteristic time/current coordination curves, to include:
        a. Utility company upstream protection device.
        b. Low voltage equipment circuit breaker trip devices.
        c. Low voltage equipment fuses.
        d. Cable damage points.
        e. Transformer data to include full load current, magnetizing inrush, and ANSI withstand parameters.
        f. Symmetrical fault current.
        g. Relevant motor damage curves.
        h. Generator Phase and ground coordination of generator protective devices.
        i. Generator damage curve.
        j. Transfer switch characteristics.
    6. Specific recommendations

7. Test instrumentation, condition, and connections, as applicable, for each study
8. Computerized fault current calculations
9. Suggested changes to the protection scheme or equipment selection that will result in improved system reliability and safety.
10. Recommendations to minimize the arc flash energy.
11. Proposed equipment labeling in accordance with NFPA 70 and NFPA 70E.

B. Submit digital files of summary report and calculation models and 4 bound copies of the report to the Engineer.

3.8 PROTECTIVE DEVICE TESTING, CALIBRATION, AND ADJUSTMENT

A. Test, calibrate, and adjust the protective relays and circuit breaker trip devices in accordance with the recommendations in the power system coordination study.

B. Calibrate both new and existing MCBs in accordance with the recommendations in the power system study.

C. Adjustments shall be made prior to energizing any electrical equipment.

3.9 FIELD TESTING

A. Coordinate the requirements of this section with field testing as specified in other sections.

3.10 LABELS

A. Provide a unique readily identifiable label applied to each overcurrent protective device after examination, calibration, testing and acceptance, that indicates the acceptance date and contact information for the agency certifying performance of overcurrent protective devices.

B. Post arc-flash hazard boundary warning signs on equipment as required by NFPA 70E.

END OF SECTION

SECTION 26 22 00 05 – DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide dry-type transformers, complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. General: Submittals shall be in accordance with MASS Section 10.05 Article 5.6 and Section 26 05 00 – Electrical Work, General.

B. Shop Drawings
   1. Transformers
      a. Dimension drawings
      b. Technical certification sheets
      c. Drawing of conduit entry/exit locations
      d. Transformer ratings, including:
         1) Voltage
         2) Continuous current
         3) Basic impulse level for equipment over 600 volts
         4) kVA
      e. Descriptive bulletins
      f. Product sheets

PART 2 - PRODUCTS

2.1 GENERAL

A. Transformers
   1. The transformers shall be dry-type, designed, manufactured, and tested in accordance with the latest applicable standards of ANSI and NEMA.
   2. Transformers shall be UL-listed and bear the UL label.

2.2 TRANSFORMERS

A. Ratings
   1. kVA and voltage ratings shall be as indicated.

2. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96 - Guide for Loading Dry Type Distribution and Power Transformers
3. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

   Up to 9 kVA 40 db

   10 to 50 kVA 45 db

   51 to 150 kVA 50 db

B. Construction
   1. Insulation Systems
      a. Transformers shall be insulated as follows:
         1) 2 kVA and below: 150 degrees C insulation system based upon 80 degree C rise.
         2) 3 to 15 kVA: 185 degrees C insulation system based upon 115 degrees C rise. 15 kVA and above: 220 degrees C insulation system based upon 150 degrees C rise.
      b. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient.
      c. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM D 635 – Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
   2. Transformer windings shall be copper.
   3. Transformers shall have four 2-1/2 percent taps, two above and two below 480 volts.

C. Drive Isolation transformers shall be sized per the table below:

HP	KVA
2	3
3	6
5	7.5
7.5	11
10	14
15	20
20	27
25	34
30	40
40	51
50	63
60	75
75	93
100	118
125	145

150	175
200	220
250	275
300	330
400	440
500	550

D. Manufacturers: Transformers shall be floor- or wall-mounted type by **General Electric, Cutler-Hammer, Square D**, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All WORK of this Section shall be installed as indicated in Section 26 05 00 – Electrical Work, General.

END OF SECTION

SECTION 26 24 13 – SWITCHBOARDS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide 480V switchboards, complete and operable, and SCADA ready as indicated and in accordance with the Contract Documents.

B. The following Sections are related to the WORK of this Section:
   1. Section 26 05 00 – Electrical Work, General
   2. Section 26 05 26 - Grounding and Bonding for Electrical Systems
   3. Section 26 05 73 - Protective Device Studies
   4. Section 26 28 17 - Insulated case circuit breakers

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Codes and Standards:

ANSI/NFPA 70	National Electrical Code
ANSI Z55.1	Gray Finishes for Industrial Apparatus and Equipment
IEEE C62.41	Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
NEMA PB 2	Dead-front Distribution Switchboards.
NEMA PB 2.1	General Instructions for Proper Handling, Installation, Operation, and Maintenance of Dead-front Distribution Switchboards Rated 600 Volts or Less.
NETA ATS	Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
UL 891	Switchboards

1.3 CONTRACTOR SUBMITTALS

A. Submittals shall conform to the requirements of Section 26 05 00 – Electrical Work, General. In addition, submit the following:

1. A complete list of special tools as may be required for the operation and maintenance of the unit.
2. Engineering data, including voltage, current, and short-circuit ratings.
3. Certified outline drawings complete with dimensions, available space for conduits, cable terminations, bus terminations, busway connections, weights, and cable supports.
4. A complete one-line diagram showing protective and control devices, metering, and terminal numbers.
5. Interconnection diagrams.
6. Design certification of the anchoring systems for seismic requirements in conformance with the requirements of Section 26 05 00 – Electrical Work, General, for the indicated equipment.
7. Spare parts data, listing source and prices of recommended replacement parts and supplies.
8. Recommended maintenance procedures and intervals.
9. Written descriptions, explaining ladder diagrams, control operation, and system operation.
10. A certified factory design test report.
11. A material list and catalog data.
12. A separate shop drawing of the proposed utility metering switchboard section shall be submitted by the CONTRACTOR to the serving electric utility for review of compliance with utility standards.

B. Closeout submittals: Comply with Contract Special Provisions, and include:
1. Project Record Documents: Record actual locations, configurations, overcurrent protective device settings, and ratings of switchboards and their components on single line diagrams and plan layouts.
2. Operation and Maintenance Data: Submit spare parts data listing; source of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.4 QUALITY ASSURANCE

A. General
1. Materials shall be tested and inspected in accordance with Section 26 05 00 – Electrical Work, General, and the requirements indicated in this Section.
2. Utility metering switchboards shall comply with the requirements of Matanuska Electric Association.
3. The manufacturer of the switchboard assemblies shall be the manufacturer of the major components within the assembly.

B. Storage and Handling
1. Switchboards shall be stored in a clean, dry space. The storage space shall be heated or space heaters shall be provided and energized.
2. Factory wrapping shall be maintained or a heavy plastic cover shall be provided in order to protect units from dirt, water, construction debris, and traffic.
3. Handle in accordance with NEMB PB 2.1. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

C. Factory Tests:
   1. Submit a certification of design tests previously conducted on one air-break circuit breaker and switchboard assembly of each rating similar to that indicated.
   2. The design testing program shall conform to the requirements of UL 891, and shall include the following tests:
      a. dielectric
      b. continuous current
      c. withstand
      d. endurance
   3. The low-voltage switchboard section, including the transition section, shall be completely assembled, wired, adjusted, and tested at the factory.
   4. After assembly, the complete switchboard shall be tested for operation under simulated service conditions in order to assure the accuracy of the wiring and the functionality of the equipment.

D. Production Testing
   1. Production tests shall be conducted on each low-voltage switchboard assembly, and a certification of each test shall be submitted.
   2. The production testing program shall conform to the requirements of UL 891, as well as the applicable standards of IEEE and of NEMA PB-2.
   3. Production testing shall include the following tests:
      a. Contact resistance measurement of all 3 phases.
      b. Operation of each electrically-operated breaker with the control power supply voltage adjusted to the limits indicated.
      c. Check of safety interlocks and interchangeability of circuit breakers of the same ratings.

E. Environmental Conditions
   1. Switchboards shall be designed for continuous duty service in the environmental conditions indicated in Section 26 05 00 – Electrical Work, General, and as specified in this Section.
   2. Switchboards shall be certified to comply with the applicable seismic requirements in accordance with Section 26 05 48.16 – Seismic Controls for Electrical Systems.

1.5 COORDINATION

A. The requirements for protective device coordination studies for electrical distribution system protection are indicated in Section 26 05 73 – Protective Device Studies.

B. Coordinate dimensions, seismic anchorage, and conduit entry requirements for switchboards with the structural foundation concrete work as indicated in Special Provisions and on the Drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Switchboards shall be front-accessible only and comply with NEMA PB 2 and UL 891.

B. Switchboards shall be a product of the manufacturer of the enclosed power air circuit breaker.

C. Switchboard electrical ratings shall be as indicated on the Drawings. The entire assembly shall be suitable for 600 volts maximum AC service.

D. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical.

E. The bus system shall have a minimum ANSI 4-cycle short-circuit withstand rating of 85,000 amperes symmetrical.

F. All circuit breakers shall have a minimum symmetrical interrupting capacity of 65,000 amperes symmetrical, but no less than required by Section 26 05 73 – Protective Device Studies. To ensure a fully selective system, all circuit breakers shall have 30 cycle short-time withstand ratings equal to their symmetrical interrupting ratings, regardless of whether equipped with instantaneous trip protection or not.

G. Switchboards shall be provided ready for SCADA interconnect.

2.2 MANUFACTURERS

A. Basis of Design: Siemens.

2.3 SWITCHBOARD CONSTRUCTION FEATURES

A. Switchboards shall consist of free-standing vertical sections with the complement of circuit breakers and accessories as indicated. The construction shall facilitate the addition of future components or sections where indicated

B. Switchboards shall consist of the required number of vertical sections bolted together to form a rigid steel structure for each assembly. All sections of the switchboard shall align front and rear with depth as shown on the Drawings. The overall enclosure shall be a NEMA 1 dead-front assembly.

C. All edges of switchboard front covers or hinged panels shall be formed. The sides and rear shall be covered with removable bolt-on covers for de-energized access only. Hinged and removable panels shall be reinforced with stiffening members in order to minimize vibration. Steel shall be of select quality, free of dents, and true to level after forming.

D. Each switchboard assembly shall be provided with suitable lifting means.

E. The drawout circuit breakers shall be housed in separate sections or compartments within vertical sections and shall be isolated from adjacent elements by the use of steel or appropriately insulated barriers.

F. All protective devices shall be front removable and compartmentalized with line and load bus connections.

G. Designated circuit breakers shall be equipped with drawout mounting rails and primary and secondary disconnecting contacts. Current transformers for feeder instrumentation, where shown on the plans, shall be located within the appropriate breaker compartments and be front accessible and removable.

H. Positive mechanical interlocks of rugged design shall prevent the breaker from being racked in or out unless the breaker is tripped and shall prevent the breaker from being closed while it is being racked in or out.

I. The removable power circuit breaker element shall be equipped with disconnecting contacts and interlocks for drawout application. It shall have four positions, “connected,” “test,” “disconnected” and “removed.” The breaker drawout element shall contain a worm gear levering “in” and “out” mechanism with removable lever crank. Levering shall be accomplished via the use of conventional tools. Mechanical interlocking shall be provided so that the breaker is in the tripped position before levering “in” or “out” of the compartment. The breaker shall include an optional provision for key locking open to prevent manual or electric closing. Padlocking shall provide for securing the breaker in the connected, test, or disconnected position by preventing levering.

J. Provide a manual release to hold the breaker in test and disconnected positions.

K. Provide a limit stop in the fully withdrawn position, in which position there shall be provisions for easy maintenance and inspection or removal.

L. Provide arc flash warning signs, short circuit current level sign.

2.4 BUS

A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on ANSI standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

B. The vertical bus in each section shall be arranged so that drawout circuit breaker modules shall be easily and quickly inserted or withdrawn.

C. The vertical bus bars in each section shall be copper. The vertical bus in each distribution section shall be extended to the maximum height available in the section. This shall allow for the future addition of feeder breakers without modification of the vertical bus.

D. Switchboards shall include provision for termination of an incoming grounded service (neutral) conductor, with a suitably marked removable neutral bus link in conformance to NEC requirements for service entrance.

E. Insulated bus supports shall be of flame-retardant polyester glass, designed and tested to withstand the mechanical stress produced by fault currents as required.

F. Bus Joints
   1. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with Belleville-type washers. Bolted or pressure joints for buses, interconnections, disconnecting devices, and external connections to the equipment shall be of copper with silver-to-silver torqued contacts.
   2. Bus joints shall be welded, brazed, or bolted.
   3. Bolted joints and connections shall be silver-plated.
   4. Bolts and associated hardware shall be corrosion-resistant

G. Insulating Barriers
   1. There shall be a vertical barrier of glass polyester between the bus compartment and the device compartments for circuit breakers, instruments, and auxiliary components.
   2. Insulating barriers shall be provided where primary buses pass from one compartment to another.
   3. Solid vertical insulating barriers shall be provided in the section between the cable and bus compartments.

H. Ground Bus
   1. A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard. The ground bus short- time withstand rating shall meet that of the largest circuit breaker within the assembly.
   2. The ground bus shall be provided with clamp type terminal lugs, adjustable between 4/0 AWG and 500 KCMIL at each end for external cable connections.
   3. All metal parts of the structure shall be effectively connected to the ground bus.

I. The ground bus shall be of rectangular cross section, not less than 1/4-inch by 1-1/2 inches.

2.5 WIRING/TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchboards shall be furnished as required. Control components mounted within the assembly shall be suitably marked for identification corresponding to the appropriate designations on manufacturer's wiring diagrams.

B. Provide a front accessible, isolated vertical wireway for routing of factory and field wiring.

C. Factory provisions shall be made for securing field wiring without the need for adhesive wire anchors.

D. Front access to all circuit breaker secondary connection points shall be provided for ease of troubleshooting and connection to external field connections without the need of removing the circuit breaker for access.

E. All control wire shall be type SIS. Wire bundles shall be secured with nylon ties and anchored to the assembly with the use of pre-punched wire lances or nylon non-adhesive anchors. All current transformer secondary leads shall first be connected to conveniently accessible shorting terminal blocks before connecting to any other device. Shorting screws with provisions for storage shall be provided.

F. All groups of control wires leaving the switchboards shall be provided with terminal blocks with suitable numbering strips and provisions for #10 AWG field connections.

G. NEMA 2-hole mechanical-type lugs shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size indicated on the drawings.

H. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the Drawings.

2.6 CONTROL WIRING

A. Provide control and communications wiring as required to auxiliary relays and devices indicated to be furnished with the equipment.

B. The control buses and wiring for each vertical section shall be enclosed in panduit or in compartments isolated from the primary circuits.

C. Terminal Blocks
   1. Every compartment containing control wiring shall have identified terminal blocks.
   2. Connections made on terminal blocks and on internal devices shall be by means of locking spade-type pre-insulated terminals.

D. Control and secondary wiring shall be 600 V and of the flame-retardant switchboard-type, with a minimum size of No. 14 AWG, stranded tinned copper. The wire shall be SIS, with both ends of the wire identified with labels approved by the ENGINEER.

E. Hinge wiring shall be of the extra-flexible stranding type.

F. SMART trip unit communications wiring shall use MODBUS protocol and interface.

2.7 CIRCUIT BREAKERS AND CIRCUIT BREAKER COMPARTMENTS

A. All protective devices shall be low voltage circuit breakers as follows:.
   1. Insulated Case: Drawout configuration or fixed mount.
   2. Molded Case: Fixed mount configuration.

B. Insulated Case Circuit Breakers: as specified in Section 26 28 17 and shall include the following provisions:

1. Siemens WL or approved equal. Insulated case breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating
2. Circuit breakers shall be electrically operated, complete with 120V AC motor operators. The charging time of the motor shall not exceed 6 seconds.
3. Power circuit breakers shall utilize a two-step stored-energy mechanism to charge the closing springs. The closing of the breaker contacts shall automatically charge the opening springs to ensure quick-break operation.
4. The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.
5. Power circuit breakers shall have bell alarms and form "C" auxiliary contacts wired to an identified terminal strip: one normally open (N.O.) and one normally closed (N.C.) dry contacts for remote indication.
6. Circuit breaker elements of the same frame size shall be interchangeable.

C. Molded Case Circuit Breakers:
1. UL 489, molded-case circuit breaker.
2. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time and short time pickup current setting for automatic operation
3. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 600 amperes and larger have changeable trip units.
4. Accessories: Conform to UL 489.
5. Handle Lock: Provisions for padlocking.

2.8 TRIP UNITS

A. Each low voltage power circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip or equal device.

B. Trip units shall be as specified in Section 26 28 17 – Insulated Case Circuit Breakers, and shall include arc flash energy reduction provisions as follows:

1. Each breaker trip unit shall be equipped with Zone Selective Interlock to reduce the time delay of the short time trip and ground fault trip in the event of a fault between the main breaker and downstream breakers.
2. Each breaker trip unit shall be equipped with a maintenance mode to manually lower the instantaneous settings for arcflash hazard reduction.

2.9 ARC FLASH ENERGY REDUCTION CONTROLS

A. Provide arc flash energy reduction controls for switchboard assemblies, to include the following:
a. One maintenance mode switch with status indication, for field installation at location in vicinity of switchboards as indicated on Drawings.

b. Proximity or perimeter detection devices for field installation as indicated on Drawings for automatic activation of arc flash energy reduction system upon detection of personnel within critical arc flash boundary area.
c. Accessory digital input module with network communication provisions between switchboard circuit breakers as required for a manually or automatically activated arc flash energy reduction system.

2.10 TEST UNIT

A. Furnish one 120 VAC static trip calibration and portable test unit for each type of circuit breaker furnished.

B. The test unit shall be as designed and built specifically for the type of circuit breakers being furnished and shall contain necessary cables, plugs and instruction manuals required for operation.

C. Test sets will not be necessary when the circuit breakers trip units include internal test capabilities by an operator.

2.11 CONTROL POWER TRANSFORMERS

A. Control power transformers shall be provided in each main circuit breaker section in order to supply power for circuit breaker control.

B. The transformer shall be protected by current limiting fuses in a dead front holder on both the primary and secondary.

C. Distribution of control power shall be through use of panel mounted fusible switches, or circuit breakers, properly coordinated.

2.12 TERMINAL BLOCKS

A. Terminal blocks for external control connections shall be if the 600 V, barrier type, having a minimum rating of 20 amperes with marker strips identifying internal and external wiring.

B. Terminal blocks shall be sized to have at least 20 percent unused spare connections after completion of wiring.

C. Terminal blocks for current transformer secondary connections shall be of the short-circuiting type.

D. One 4-pole block shall be used for each current transformer set.

2.13 METERS AND INSTRUMENTS

A. Meters and instruments shall be provided as indicated. Solid State Meter shall be an Allen Bradley Bulletin 1404 model 3000 power monitor with Ethernet connection and display or equal.

B. Meters and instruments shall be installed and wired on hinged front panels.

C. The arrangement of the meters and instruments is subject to approval by the ENGINEER.

D. Instruments and meters shall be of the semi-flush switchboard type, with rectangular dustproof enclosing cases and antiglare glass.

E. Instruments and meters shall be suitable for operating from instrument transformers with nominal 5-ampere and 120 V secondaries.

F. Multi-function microprocessor based electronic metering panels are acceptable in lieu of analog type instruments.

2.14 INSTRUMENT TRANSFORMERS

A. Potential Transformers
   1. The quantity, ratio, and connection of potential transformers shall be provided as indicated.
   2. Potential transformers shall be provided with current-limiting high-interrupting-capacity primary fuses in dead front-holders and shall be mounted in the auxiliary section.

B. Current Transformers
   1. The quantity and ratio of current transformers shall be as indicated.
   2. Current transformers shall have thermal and mechanical ratings and insulation class not less than those of the associated circuit breakers.
   3. Current transformers shall be mounted in such a way as to provide easy access for inspection and maintenance.

C. Provide test blocks and plugs for current and potential circuits for the main breaker(s).

2.15 NAMEPLATES

A. Nameplates shall be provided for the front and rear face of each cubicle and for major devices thereon, such as meters, instruments, control switches, and relays.

B. Nameplates shall also be provided for major internal devices such as relays, instrument and control power transformers, fuse blocks, switches, and transformers.

C. Cubicle nameplates shall be constructed of 3-layer laminated phenolic plastic, with a black front and back, a white case, and engraved to show white lettering.

D. The lettering shall be upper case as follows:

1. one-inch high for switchboard identification
2. 7/16-inch high for compartment identification
3. 1/8-inch high for component nameplate

E. Nameplates that are 1-1/2 inches tall and smaller shall be 1/16-inch thick.

F. Nameplates larger than 1-1/2 inches tall shall be 1/8-inch thick.

G. The edges of the nameplates shall be beveled.

H. Nameplates shall be fastened with black anodized screws.

2.16 REMOTE OPERATOR EQUIPMENT:

A. Provide a remote racking device and remote operator pendant device to safely rack out a breaker or operate a breaker while it is in service. The remote racking device shall have the following:
1. Torque control to prevent damage to breaker.
2. The racking device operator controls shall contain indicator lights to show
   a. Connected
   b. Disconnected
   c. Test

2.17 SURFACE PREPARATION, PAINTING, AND CLEANLINESS

A. Metal surfaces shall be smooth and free of all foreign matter such as scale, sand, blisters, weld splatter, metal chips and shavings, oil, grease, organic matter, and rust, and shall be chemically cleaned and treated with a process which provides a phosphate coating.

B. Immediately after the treatment process, the surfaces shall be sprayed with a coating each of primer and finish paint, and both coatings shall be baked.

C. Electrostatically deposited powder coated epoxy finishes, oven baked 2-mils minimum thickness outdoor, will be acceptable.

D. Each surface shall be finish painted gray.

E. The manufacturer's standard practice of double-tone finish on the low-voltage switchboard section will be acceptable.

F. Furnish 2 spray cans of air-drying paint of each color tone.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall install switchboards in accordance with the manufacturer's instructions.

B. Prior to energizing, the equipment shall be cleaned, inspected for loose connections, checked out for electrical and mechanical operations, phase-sequenced, and all circuits shall be made free of any shorts of ground connections following field testing.

C. The CONTRACTOR shall anchor the switchboards in conformance with "Equipment Anchoring" criteria indicated in Section 26 05 00 – Electrical General Provisions.

3.2 MANUFACTURER'S REPRESENTATIVE

A. Arrange for a technical service representative of the manufacturer for pre-commissioning checkout of the equipment and to instruct the operating personnel in the operation, shutdown, startup, and maintenance of the equipment.

3.3 TRAINING

A. The Contractor shall provide a training session for OWNER’s representatives for two normal workdays at a jobsite location determined by the OWNER.

B. The training session shall be conducted by a manufacturer’s qualified representative.

C. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.

3.4 FIELD TESTING

A. CONTRACTOR shall perform all testing required by Section 26 01 26 – Electrical Tests, and as follows:
   1. Inspect and test in accordance with NETA ATS, except Section 4.
   2. Perform inspections and tests listed in NETA ATS, Section 7.1.

B. Coordinate field testing with results of Section 26 05 73 – Protective Device Studies.

C. Provide the services of a qualified factory-trained manufacturer’s representative to assist the CONTRACTOR in installation and start-up of the equipment specified under this section until furnished equipment has been thoroughly tested and is fully operational under the requirements of the project CONTRACT DOCUMENTS. The manufacturer’s representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

END OF SECTION

SECTION 26 24 16.05 – PANELBOARDS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide panelboards complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. General: Submittals shall be in accordance with MASS Section 10.05 Article 5.6 and Section 26 05 00 – Electrical Work, General.

B. Shop Drawings
   1. Breaker layout drawings with dimensions and nameplate designations
   2. Component list
   3. Drawings of conduit entry/exit locations
   4. Assembly ratings including:
      a. Short circuit rating
      b. Voltage
      c. Continuous current
   5. Cable terminal sizes
   6. Descriptive bulletins
   7. Product sheets
   8. Installation information
   9. Seismic certification and equipment anchorage details

PART 2 - PRODUCTS

2.1 PANELBOARDS

A. Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1-Panelboards, as well as the provisions of UL 50 – Safety Enclosures for Electrical Equipment and UL 67 – Safety Panelboards. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-volt, 3-phase operation or 120/240-volt for single phase operation as indicated. Power panelboards shall be rated for 480 volts, 3-phase, 3-wire operation.

B. The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers.

C. Ratings

1. Panelboards rated 240 VAC or less shall have short circuit ratings not less than 10,000 amps RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.
2. Panelboards rated 480 VAC shall have short circuit ratings not less than 25,000 amps RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.
3. Panelboards shall be labeled with a UL short circuit rating. Series ratings are not acceptable.
4. The VFD circuit breakers shall be time-delay units, shall be UL-listed for VFD loads, and approved by the VFD manufacturer for protection of their drives.

D. Construction
1. All lighting and power distribution panels shall have copper bus bars.
2. Breakers shall be one, two, or three pole as indicated, with ampere trip ratings as required by the equipment. Breakers shall be quick-make and quick-break, inverse time trip characteristics, to trip free on overload or short circuit, and to indicate trip condition by the handle position.
3. The panels shall have hinged doors with combination catch and latch. The front panels shall be so arranged that when the plates are removed, the gutters, terminals and wiring will be exposed and accessible. The doors shall have inner doors within the plates to have only the breaker operating mechanism exposed when they are opened. Live conductors and terminals shall be concealed behind the plates.
4. All panelboards shall be rated for the intended voltage.
5. All circuit breakers shall be interchangeable and capable of being operated in any position as well as being removable from the front of the panelboard without disturbing adjacent units. No plug-in circuit breakers will be acceptable.
6. Lighting and power distribution panels which are not part of a motor control center shall be constructed in accordance with Section 26 05 00 – Electrical Work, General. Panels shall have the necessary barriers, supports, and liberal wiring gutters. Trim screws shall be stainless steel. All panelboard parts of metal other than copper, aluminum, or stainless steel shall be cadmium plated. Panelboards shall be as manufactured by **Allen-Bradley, General Electric,** or **Cutler-Hammer**.
7. Panelboards shall be UL listed except for special enclosures which are not available with UL listing.
8. Panelboards shall be suitable for use as service entrance as indicated or as otherwise required by the N.E.C.

PART 3 - EXECUTION

3.1 GENERAL

A. All WORK of this Section shall be installed as indicated in Section 26 05 00 – Electrical Work, General.

END OF SECTION

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all wiring devices, plates, and nameplates in accordance with the Contract Documents.

B. The requirements of Section 26 05 00 – Electrical Work, General apply to this Section.

C. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6.

B. Shop Drawings
   1. Complete catalog cuts of switches, receptacles, enclosures, covers, and appurtenances, marked to clearly identify proposed materials.
   2. Documentation showing that proposed materials comply with the requirements of NEC and UL.
   3. Documentation of the manufacturer's qualifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. All devices shall carry the UL label.

B. General purpose duplex receptacles and toggle switch handles shall be brown everywhere except in finished rooms where they shall be ivory. Special purpose receptacles shall have a body color as indicated. Receptacles and switches shall conform to Federal Specifications W-C-596E and W-S-896E, respectively.

2.2 LIGHTING SWITCHES

A. Local branch switches shall be toggle type, rated at 20 amps, 120-277 VAC, and shall be **General Electric Cat. No. GE-5951-1** for single pole, **GE-5953-1** for 3-way and **GE-5954-1** for 4-way, or similar types as manufactured by **Hubbell**, or equal.

2.3 GENERAL PURPOSE RECEPTACLES

A. Duplex receptacles rated 120-volt, 20 amps shall be polarized 3-wire type for use with 3-wire cord with grounded lead and 1 designated stud shall be permanently grounded to the conduit system (NEMA 5-20R). Duplex 120-volt receptacles shall be **G.E. 5362, Hubbell 5362**, or equal. Single receptacles shall be **G.E. 4102, Hubbell 4102**, or equal.

B. Ground-fault circuit interrupting receptacles (GFCI's) shall be installed at the locations indicated. GFCI's shall be rated 125-volt, 20 amps and shall be **Hubbell GF-5362**, or equal.

C. Receptacles for hazardous locations shall be single gang receptacles with spring door. Receptacles shall have a factory sealed chamber. The receptacles shall have a delayed action feature requiring the plug to be inserted in the receptacle and rotated before the electrical connection is made. The receptacle shall not work with non-hazardous rated plugs. One plug shall be furnished with each receptacle. The receptacles shall be rated for 20 amps at 125 VAC. Hazardous location receptacles shall be **Appleton EFSB, Crouse-Hinds ENR**, or equal.

D. Where indicated, hazardous location receptacles shall be provided with ground fault protection. Ground fault protection shall be **Appleton EFSR-GFI, Crouse-Hinds GFS 1**, or equal.

2.4 LOCKING RECEPTACLES

A. Receptacles for all existing chemical feed pumps and all new sump pumps shall be locking receptacles. Provide matching plugs.
   1. Single-phase locking receptacles shall be **Pass & Seymour Turnlok L630-R receptacle** and **CRL630-P plug**, or equal.
   2. Three-phase locking receptacles shall be 250-volt, 20-amp, 4-wire, **Pass & Seymour Turnlok L1520-R receptacle** and **L1520-P plug**, or equal.

2.5 ENCLOSURES AND COVERS

A. Surface mounted switches and receptacles shall be in FS or FD type cast device boxes.

B. In finished areas, switch and receptacle boxes shall be provided with SUPER STAINLESS STEEL COVERS as manufactured by **Harvey Hubbell, Arrow Hart, Bryant**, or equal.

C. In areas where cast boxes are used, switch and receptacle covers shall be **Crouse-Hinds Catalogue No. DS185 and WLRD-1, or Adalet No. WSL and WRD**, or equal.

D. Receptacles in exterior locations shall be with s-hinged cover/enclosure marked “Suitable for Wet Locations when in use” and “UL Listed.” There shall be a gasket

between the enclosure and the mounting surface and between the hinged cover and mounting plate/base. The cover shall be **TayMac Specification Grade**, or equal.

2.6 NAMEPLATES

A. Provide nameplates or equivalent markings on switch enclosures to indicate ON and OFF positions of each switch. ON and OFF for 3-way or 4-way switches is not acceptable. Provide receptacles for special purposes with nameplates indicating their use. Conform to requirements of Section 26 05 00 – Electrical Work, General.

PART 3 - EXECUTION

3.1 CONNECTION

A. Securely fasten nameplates using screws, bolts, or rivets centered under or on the device, unless otherwise indicated.

3.2 GROUNDING

A. Ground all devices, including switches and receptacles, in accordance with NEC, ART 250, and Section 26 05 26 – Grounding.

B. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.

C. Ground flush receptacles and their metal plates through positive ground connections to outlet box and grounding system. Maintain ground to each receptacle by spring-loaded grounding contact to mounting screw or by grounding jumper, each making positive connection to outlet box and grounding system at all times.

3.3 FIELD TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 26 05 00 – Electrical Work, General.

B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.

END OF SECTION

SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fusible switches, non-fusible switches, and molded-case circuit breakers in Individual enclosures.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 – Low Voltage Cartridge Fuses.
   2. NEMA KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximu).

B. International Electrical Testing Association:

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

C. Underwriters Laboratories Inc.:

   1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6 and Section 26 05 00 – Electrical Work, General.

B. Product Data: Submit catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and continuous current ratings of enclosed circuit breakers.

PART 2 - PRODUCT

2.1 MANUFACTURERS

A. Siemens

B. Square D

C. Eaton

2.2 MOLDED CASE CIRCUIT BREAKER

A. Product Description: Enclosed, molded-case circuit breaker conforming to UL 489, suitable for use as service entrance equipment where applicable.

B. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time and short time pickup current setting for automatic operation.

C. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.

D. Accessories: As indicated on Drawings. Conform to UL 489.
   1. Handle Lock: Provisions for padlocking.
   2. Insulated neutral: As applicable for the circuit.
   3. Grounding Lug: In each enclosure.

E. Enclosure: UL 250, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   1. Interior Locations: NEMA 12, unless other area condition specified.
   2. Exterior and NEMA 4X Locations: Type 4X.

F. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar

2.3 FUSIBLE SWITCH ASSEMBLIES

A. Description: NEMA KS 1, Type HD, enclosed load interrupter knife switch. Handle lockable in OFF position.

B. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

C. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses.

D. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.

E. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard finish or stainless steel.

F. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

G. Furnish switches with entirely copper current carrying parts.

2.4 NONFUSIBLE SWITCH ASSEMBLIES

A. Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.

B. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

C. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses.

D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard finish or stainless steel.

E. Furnish switches with entirely copper current carrying parts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed circuit breakers and switches plumb..

B. Height: 5 feet to operating handle.

C. Install grounding and bonding in as specified in Section 26 05 26..

D. Locate and install engraved plastic nameplates as specified in Section 26 05 00.

3.2 FIELD QUALITY CONTROL

A. Provide field inspecting, testing, adjusting, and balancing.
   1. Inspect and test in accordance with NETA ATS, except Section 4.
   2. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1.
   3. Adjust trip settings to coordinate circuit breakers with other overcurrent protective devices in circuit.
   4. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION

SECTION 26 28 17 – INSULATED CASE CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SCOPE

A. This section defines low voltage insulated case circuit breakers for use in AC systems, rated 600 V or less.

B. Related Sections include the following:
   1. Section 26 05 73 – Protective Device Studies
   2. Section 26 24 13 – Switchboards

1.2 RELATED STANDARDS

A. Comply with requirements of latest revisions of applicable industry standards, specifically including the following:
   1. UL489 – Low Voltage AC Circuit Breakers

1.3 SUBMITTALS

A. Product Data: Include features, characteristics and ratings of individual circuit breakers and other components. In addition, time-current characteristic curves for over current protective devices, including circuit- breaker trip devices and fusible devices.

B. Manufacturer Seismic Qualification: Breakers shall meet and be certified to seismic requirements specified in the IBC International Building Code. The switchboard manufacturer shall supply mounting and anchorage requirements.

1.4 DELIVERY, STORAGE AND HANDLING

A. Circuit breakers for switchboards shall be shipped inside their respective compartments in which they were factory acceptance tested.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturers are as follows:
   1. Siemens (Basis for Design)
   2. Eaton
   3. Square D

2.2 RATINGS

A. Voltage and current ratings shall be as indicated on the Drawings. The low voltage insulated case circuit breaker shall be utilized on no more than a 600 V AC system.

B. The low voltage circuit breaker shall be designed to withstand the mechanical forces associated with an available symmetrical short-circuit fault level as found in the Protective Device Study, at the voltage supplied as indicated on the Drawings.

C. Breakers shall be service rated where applicable.

2.3 GENERAL REQUIREMENTS

A. Circuit breakers shall comply with the requirements of UL 489. Breakers shall be three-pole, 100% rated type or approved equal.

1. Circuit breaker element shall have spring charged/discharged indicators and circuit breaker open or closed and ready to close indicators all of which shall be visible to the operator with the compartment door closed. Additionally, circuit breaker open and closed status signals shall be communicated to the plant wide SCADA system.

B. Ratings: Interrupting up to 150 kA at 480V without fuses. Short time current ratings for each circuit breaker shall be as indicated on the Drawings or data tables. Circuit breakers shall be 600-volt class.

C. Operating Mechanism: Mechanically and electrically trip-free, stored- energy operating mechanism with the following features:

1. Normal Closing Speed: independent of both control and operator
2. Motor operator, field installable with manual charging
3. Operations counter
4. Shunt Trip Coil
5. Remote Close Coil

D. Each low voltage circuit breaker shall be equipped with a self-powered, microprocessor-based trip-device to sense overload and short circuit conditions. The device shall measure true RMS current. The tripping system shall consist of high accuracy (<1%) Rogowski coil sensors on each phase, a release mechanism and the following features:

1. Field Installable and interchangeable front mounted trip units. Trip units can be upgraded for future expansion in functionality, such as communication.

2. Functions: Long time, short time and extended instantaneous protection function shall be provided (EIP) to allow the breaker to be applied at the withstand rating of the breaker with minus 0% tolerance so that there is no instantaneous override. This feature shall furthermore allow the circuit breaker to be applied up to the full instantaneous rating of the breaker on systems where the available fault current exceeds the breakers withstand rating. Each shall have an adjustable pick-up setting. In addition, long time and short time bands shall each have adjustable time delay. Short time improve co-ordination with fuses or inverse relays.
3. Individual LED's shall indicate an overcurrent, short circuit or ground fault trip condition.
4. Time-current characteristics shall be field adjustable locally or optionally remotely via a bus system, Modbus.
5. Pickup Points: 10 Long Time Settings.
6. Field installable zone selective interlocking: Connections will be made between main, tie and feeder circuit breakers to ensure that the circuit breaker closest to the fault trips for short time and ground fault conditions.
7. Communications and power monitoring functions shall be provided.
8. Modbus communication shall be provided to plant SCADA. Power monitoring, breaker status and remote breaker setting shall be via the Modbus communications interface.
9. The option to remotely switch protection settings shall be provided for reduced arc-flash maintenance mode and whenever a generator is part of the power distribution system.
10. Field installable configurable analog and digital output relays shall be available to connect directly to the trip unit.
11. Current adjustability can be accomplished by use of a keypad and rating plugs on trip units. The rating plug shall be front mounted and upgradeable. Upgrades to the rating plugs shall not require changes to the CT.

E. The trip units shall also contain the following features:
1. Long, Short and Ground settings shall be adjustable via the use of dial settings and rating plugs on trip units. The rating plug shall be front mounted and upgradeable. Upgrades to the rating plugs shall not require changes to the CT.
2. Instantaneous adjustability shall be accomplished by use of dial settings and rating plugs on trip units. The rating plug shall be front mounted and upgradeable. Upgrades to the rating plugs shall not require changes to the CT.
3. Ground-fault protection shall be included with at least three time-delay bands and an adjustable current pickup and an I^2t ramp. Arrange to provide protection for service as shown on the Drawings.
4. A LCD display shall be available to simplify settings & viewing data locally.
5. Waveform capture and display shall be accomplished on the trip units LCD display.

F. Terminal block connections shall be front mounted and utilize screw type terminals.

G. Control Switch: One for each electrically operated circuit breaker.

H. Activation switch and Dynamic Arc Sentry (DAS) with visual status indication for each circuit breaker. SMART DAS feature allows for local or SCADA control via Modbus network.

I. Shunt-Trip: Field installable.

J. Breaker Status Sensor: measures internal breaker temperature, breaker contact position, shunt trip status, breaker ready-to-close and closing spring charges status via Modbus network.

K. Indicating Lights: To indicate circuit breaker is open or closed, for electrically operated circuit breakers. Circuit breaker open status signal shall be communicated to the plant wide SCADA system.

2.4 ACCESSORIES

A. Accessories shall be front mounted. Modular communications and relaying accessories shall be included as required for circuit breakers to be ready for future SCADA interconnect by the Owner. It shall not be necessary for the manufacturer's personnel to retrofit accessories.

B. Field interchangeable accessories shall include CT's, trip units and all internal & external accessories.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine elements and surfaces to receive circuit breaker for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install the circuit breaker in accordance with manufacturer's instructions.

C. Tighten bus joints, electrical connectors and terminals according to manufacturer's published torque-tightening values. Install equipment- grounding conductors for switchboards with ground continuity to main electrical ground bus.

3.2 ADJUSTMENTS AND CLEANING

A. Set field-adjustable trip devices per completed and approved Protective Device Study. See Specification Section 26 05 73 – Protective Device Studies.

B. Clean exposed surfaces using manufacturer recommended materials and methods. Touch-up damaged coating and finishes using non-abrasive materials and methods recommended by manufacturer. Eliminate all visible evidence of repair.

3.3 TESTING

A. Test trip, ground fault, communications, etc., functions of the circuit breaker in normal and maintenance modes in accordance with manufacturer's recommendations.

B. Acceptance testing of low-voltage circuit breakers must include low resistance, contact resistance, insulation resistance, trip and close coil voltages and primary current injection testing. and dielectric absorption testing

C. Verify proper communications with plant SCADA system is available, to include power monitoring on each feeder circuit, breaker status, trip setting status – normal, maintenance mode and generator mode.

3.4 WARRANTY

A. Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than eighteen months from date of shipment.

3.5 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and as follows:

1. Verify that circuit breaker is installed and connected according to the Contract Documents.
2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
3. Inspect and test in accordance with NETA ATS, except Section 4.
4. Perform inspections and tests listed in NETA ATS, Section 7.1.

C. Train Owner's maintenance personnel on procedures and schedules for energizing and de-energizing, troubleshooting, servicing and maintaining equipment. Provide four (4) hours of training. Availability of trainees varies and shall be coordinated with the Owner.

END OF SECTION

SECTION 26 29 13 – ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall provide manual and magnetic motor controllers in individual enclosures., complete and operable in accordance with the Contract Documents.

B. Coordination: Equipment provided under this Section shall operate the electric motor and driven equipment indicated under other equipment specifications. The CONTRACTOR shall coordinate WORK under this Section with other Sections of the WORK.

1.2 REFERENCES

A. 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 ICS 6 - Industrial Control and Systems: Enclosures.
   5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. Underwriters Laboratories Inc.:
   1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6, except that Shop Drawing information for the drives shall be submitted as part of the information for the driven equipment.
   1. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Siemens

B. Square D

C. Eaton

D. Allen-Bradley

2.2 MANUAL MOTOR CONTROLLER

A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, toggle operator.
   1. Enclosure: NEMA ICS 6, Type to meet conditions of installation.

2.3 FRACTIONAL-HORSEPOWER MANUAL CONTROLLER

A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, toggle operator.
   1. Enclosure: NEMA ICS 6, Type to meet conditions of installation.

2.4 MOTOR STARTING SWITCH

A. Product Description: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with toggle operator.
   1. Enclosure: NEMA ICS 6, Type to meet conditions of installation.

2.5 FULL-VOLTAGE NON-REVERSING CONTROLLERS

A. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
   1. Control Voltage: 120 volts, 60 Hertz.
   2. Overload Relay: NEMA ICS 2; bimetal or solid state relay.
   3. Product Features:
      a. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
      b. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oiltight type.
      c. Indicating Lights: LED type.
      d. Selector Switches: Hand-Off-Auto, rotary type.
      e. Control Power Transformers: 120 volt secondary, in each motor starter. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

4. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.
5. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard finish, or stainless steel.

2.6 TWO-SPEED CONTROLLERS

A. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Include integral time delay transition between FAST and SLOW speeds.
   1. Control Voltage: 120 volts, 60 Hertz.
   2. Overload Relay: NEMA ICS 2; bimetal or solid state relay.
   3. Product Features:
      a. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
      b. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oiltight type.
      c. Indicating Lights: LED type.
      d. Selector Switches: Hand-Off-Auto, rotary type.
      e. Control Power Transformers: 120 volt secondary, in each motor starter. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
   4. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.
   5. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard finish, or stainless steel.

PART 3 - EXECUTION

3.1 GENERAL

A. Install enclosed controllers in accordance with manufacturer's published instructions.
   1. Verify that the overload devices are properly adjusted for the equipment installed.
   2. After the equipment is installed, touch up scratches and verify that nameplate and other identification is accurate.
   3. Install engraved nameplates.

3.2 FIELD QUALITY CONTROL

A. 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 7.16.1.

END OF SECTION

SECTION 26 29 23 – VARIABLE FREQUENCY DRIVE UNITS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide variable frequency drive (VFD) units, complete and operable, in accordance with the Contract Documents. It is the intent of this Section to require complete, reliable, fully tested variable frequency drive systems suitable for attended or unattended motor control operation.

B. Related Sections:
   1. Section 26 05 00 – Electrical Work, General

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6.

B. Product Data Sheets: include the following information:
   1. Equipment information
      a. Name of drive manufacturer
      b. Type and model with complete catalog number and explanation
      c. Assembly drawing and nomenclature
      d. Maximum heat dissipation capacity in kW
   2. Enclosure rating, ampere/horsepower ratings, fault ratings, nameplate data, etc.
   3. Operator and communications interface provisions.
   4. Warranty.
   5. Circuit breaker type and rating requirements.
   6. UL listing.

C. Shop Drawings:
   1. Elevation drawings: Include dimensions and conduit entrance provisions.
   2. Assembly drawing and nomenclature.
   3. Wiring diagrams:
      a. Power diagram: Include amperage ratings, circuit breaker type and ratings.
      b. Control diagram: Include disconnect, indication, and control interface devices.

1.3 CLOSEOUT SUBMITTALS

A. Submit under provisions of MASS Section 10.05 Article 5.6.

B. The Technical Manual shall contain the following documentation:

1. Manufacturer's 2 year warranty.
2. Field test report.
3. Shop drawings: final as shipped.
4. Operation and Maintenance data:
    a. VFD and Operator Interface user manuals.
    b. Programming procedure and program settings as commissioned.
    c. Troubleshooting/Service Manuals.
    d. Service and contact information.
    e. Spare Parts List: Information for parts required by this Section plus any other spare parts recommended by the controller manufacturer.

1.4 QUALITY ASSURANCE

A. Single Manufacturer: Provide the products of one manufacturer in order to standardize appearance, operation, maintenance, spare parts, and manufacturer's services.

B. Qualifications:
1. VFD units and all associated optional equipment shall be UL Listed or Recognized, and shall contain a UL label attached on the inside of the enclosure cabinet.
    a. Listed to UL 61800-5-1 up to 600Vac.
2. VFD units shall be factory pre-wired, assembled and tested as a complete package.
3. Certified compliant with Electric Power Research Institute (EPRI) standards SEMI F47 and IEC 61000-4-34.
4. The VFD shall meet the seismic requirements of the following standards when installed according to the manufacturer’s instructions:
    a. American Society of Civil Engineering ASCE 7-10
    b. The International Building Code IBC

C. Coordinate VFD units for operation with Owner-furnished process equipment and motor provisions under this project. The Contractor shall be responsible for matching the controller to the load, speed and current of the actual motor being controlled.

D. Comply with NFPA 70.

1.5 WARRANTY

A. The manufacturer shall provide their standard parts warranty for eighteen (18) months from the date of shipment or twelve (12) months from the date of being energized, whichever occurs first.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Contractor shall provide variable frequency drives, stand-alone units or units integrated into motor control centers arranged as shown on the Drawings.

B. Variable-frequency drives for motors rated 10 Hp (7.5 kW) and larger shall use an Active Front End (AFE) low harmonic design and shall contain all components required to meet the performance, protection, safety and certification criteria of this specification.

C. Unless otherwise indicated by exception, VFD units shall be selected and rated for:
   1. NORMAL duty applications as specified herein.
   2. Variable torque application (centrifugal pumps, typical).
   3. 480VAC 3-phase 60 Hertz power supply.

D. Service Conditions: VFD units shall be designed and constructed to satisfactorily operate within the following service conditions without derating.
   1. Ambient temperature: -20 to +40 degrees C.
   2. Humidity: 5 to 95 percent, non-condensing.
   3. AC line voltage variation: plus 10 percent to minus 10 percent.
   4. AC line frequency variation: plus and minus 2 hertz.
   5. Duty load ratings:
      a. Systems rated at Normal Duty loads shall provide 110% overload capability for up to one minute and 150% for up to 3 seconds.
      b. Systems rated at Heavy-Duty loads shall provide 150% overload capability for up to one minute and 180% for up to 3 seconds.

2.2 MANUFACTURERS

A. Variable frequency drive units shall be Allen-Bradley Powerflex 755TL, or an approved equal product.
   1. Basis of design: Space for equipment on Drawings is based on Allen-Bradley products. Contractor shall make all necessary modifications as required for equipment by other manufacturer.

2.3 EQUIPMENT

A. VFD Architecture
   1. Adjustable frequency motor controllers designed to convert the incoming 3 phase, 60 Hertz power to a DC voltage and then to adjustable frequency 3-phase AC by use of a 3 phase inverter. VFD units shall vary both the AC voltage and frequency simultaneously to operate the motor at required speeds.

2. Voltage source design producing a pulse-width-modulated type output. Current source inverters will not be acceptable.
3. Shall use a transistor-based Active Front End (AFE) as the input rectifier equipped with a Selective Harmonic Elimination algorithm that mitigates harmonic levels in compliance with IEEE-519-2014, without the need for phase shifting transformers and multi-pulse diode rectifiers. Total current harmonic distortion shall not exceed 5% at the VFD input terminals at full load conditions. AFE rectifier shall be phase rotation insensitive, tolerant of line voltage imbalance up to 10% without affecting the harmonic mitigation or VFD output, and capable of operating the motor at full output with a 10% drop on input voltage.
4. Shall use an LCL filter assembly to filter up to and including the 50th harmonic to reduce EMI/RFI emissions. The LCL filter assembly shall include Passive Dampening. The drive will provide Active Resonance Detection and Protection to minimize any damage to the drive from supply side resonance.
5. Designed to operate 3-phase, 60 Hertz, NEMA-B, open drip-proof (1.15 SF) or TEFC (1.15 SF), squirrel-cage high efficiency inverter duty induction motors over the range of 50-100 percent of base speed without derating or requiring any motor modifications.
6. Capable of delivering nameplate horsepower exclusive of service factor without the need for mandatory thermostats or feedback tachometers. VFD units shall be sized to match the KVA and inrush characteristics of the motors.
7. The VFDs shall be of modular design with the following major components:
    a. AC pre-charge module.
    b. LCL filter modules
    c. Line side converter IGBT power modules
    d. Motor side inverter IGBT power modules
8. Motor side inverters, line side converters and LCL filter modules (for 250 Hp and larger drives) shall be on roll-out chassis with front accessible connections for ease of repair or replacement and to provide access to load cables. Motor side inverter modules shall be removable without disturbing the load cables after installation. Line converter modules and load inverter modules sections (for drives greater than 250 Hp) shall be interchangeable so as to reduce necessary spare parts.
9. The drive shall have a built-in circuit breaker as part of the drive's pre-charge circuit (250 hp and up) or provide built-in electrical connections for one to be field connected (10hp-250hp).

B. Features:
1. The drive shall have two sets of tuning settings for the configuration of the line side converter such that appropriate values can be selected for two input sources (example: main utility power or back-up generator) and can be selected from the Human Interface Module or communications network.
2. Voltage Sag Ride-Through: The VFD shall meet voltage sag ride-through

requirements of EPRI standard SEMI-F47, in which the VFD system shall attempt to ride through power dips up to 20% of nominal. The duration of ride-through shall be inversely proportional to load. For outages with greater than 20% dip, the drive shall stop the motor and issue a power loss alarm signal.

3. Run on Power Up: The VFD system shall provide circuitry to allow for remote restart of equipment after a power outage. Unless indicated in the Contract Drawings, faults due to power outages shall be remotely resettable.
4. Use latest generation IGBT inverter and converter sections that shall not require commutation capacitors.
5. Auto Reset/Run: For faults other than those caused by a loss of power or any other non-critical fault, the drive system shall provide a means to automatically clear the fault and resume operation.
6. The VFD lineside converter carrier frequency shall be fixed at 4 kHz.
7. The VFD motor side inverter frequency output will be sine coded PWM with a carrier frequency that can be selected at 1.33 kHz, 2 kHz, or 4 kHz, and shall be capable of the following maximum frequency outputs:
    a. 325 Hz when operating with an output carrier frequency of 1.33 kHz or 2 kHz.
    b. 590 Hz when operating with an output carrier frequency of 4 kHz

C. Enclosure:
1. Shall be rated UL Type 12 unless otherwise indicated.
2. Shall be painted per the manufacturer's standard.
3. Shall provide entry and exit locations for power cables as indicated on Drawings.
4. The drive system nameplate shall be marked with system Short Circuit Current Rating (SCCR).
5. Drive Enclosure Input Disconnect:
    a. Provide an enclosure door interlocked disconnect with fusing, or disconnect, or thermal magnet circuit breaker.
    b. Operator Handles:
        1) Provide externally operated main disconnect handle.
        2) Handles shall be lockable.

D. Input Protection: VFD shall include integral high-speed fuses to protect the solid state input components from an internal fault condition.

E. Efficiency: The minimum VFD unit efficiency shall be 95 percent at 100 percent speed and load, and 85 percent at 50 percent speed and load.

F. Displacement Power Factor: The AFE line side converter shall be capable of maintaining a minimum true power factor of up to 0.98 across the entire speed range.

G. Control Logic:

1. The VFD shall shut down in an orderly manner when a power outage occurs on one or more phases. Upon restoration of power and a "start" signal, the motor shall restart and run at the speed corresponding to the current process input signal.
2. Ability to operate with motor disconnected when in V/Hz mode.
3. Provide a controlled shutdown, when properly protected, with no component failure in the event of an output phase-to-phase or phase-to-ground short circuit. Provide annunciation of the fault condition.
4. Provide multiple programmable stop modes including Ramp, Coast, Decel-to-Hold, and Current Limit Stop.
5. Provide multiple acceleration and deceleration rates
6. Ability to configure the VFD for an emergency operation mode.
7. Ability to control outputs and manage status information locally within the VFD.
8. Ability to function stand-alone or complementary to supervisory control.
9. Ability to provide scaling, selector switches, or other data manipulations not already built into the VFD.
10. Inrush current adjustable between 50 and 110 percent of motor full load current (factory set at 100 percent).
11. On loss of input reference signal, the VFD shall operate at a preset speed or hold last state at time of signal loss.
12. Provide a minimum of three selectable frequency jump points that lock out continuous operation at critical resonance frequencies of the driven system.

H. Reference Signals:
1. VFD units shall be capable of using the following input reference signals:
   a. Analog inputs
   b. Preset speeds
   c. Remote potentiometer
   d. Digital motor operated potentiometer (MOP)
   e. Human Interface Module
   f. Communication networks
2. Loss of Reference: The drive shall be capable of sensing reference loss conditions. In the event of loss of the reference signal, the drive shall be user programmable to perform the following:
   a. Fault the drive and coast to stop.
   b. Issue a minor fault - allows the drive to continue running while some types of faults are present.
   c. Alarm and maintain last reference.
3. When using a communications network to control the drive, the communications adapter shall have these configurable responses to network disruptions and controller idle (fault or program) conditions:
   a. Fault
   b. Stop
   c. Zero Data

d. Hold Last State
e. Send Fault Configuration

I. Adjustments
1. A digital interface can be used for all set-up, operation and adjustment settings.
2. Adjustments shall be stored in nonvolatile memory.
3. No potentiometer adjustments shall be required.

J. Process PID Control
1. The drive shall incorporate an internal process PI regulator with proportional and integral gain adjustments as well as error inversion and output clamping functions.
2. The feedback shall be configurable for normal or square root functions. If the feedback indicates that the process is moving away from the set-point, the regulator shall adjust the drive output until the feedback equals the reference.
3. Process control shall be capable of being enabled or disabled with a hardwire input. Transitioning in and out of process control shall be capable of being tuned for faster response by preloading the integrator.
4. Protection shall be provided for a loss of feedback or reference signal.

K. Inputs and Outputs
1. Input / Output option modules shall consist of both analog and digital I/O.
2. No jumpers or switches shall be required to configure digital inputs and outputs.
3. All digital input and output functions shall be fully programmable.
4. Inputs shall be optically isolated from the drive control logic.
5. The control interface card shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed, and enable.
6. The VFD shall be capable of supporting up to 10 analog inputs, 10 analog outputs, 31 digital inputs, 10 relay outputs, 10 transistor outputs, and 5 positive temperature coefficient (PTC) inputs.
7. Input / Output option modules shall include at least three programmable digital outputs and as shown on the Contract Drawings.
   a. VFD Running
   b. VFD Fail
   c. VFD Ready

L. Motor Control
1. Selectable Sensorless Vector, Flux Vector, V/Hz, economizer mode selectable through programming.
2. The drive shall be supplied with an auto-tune mode.
3. V/Hz mode shall be programmable for fan or pump curve, or full custom patterns.
4. Capable of Open Loop V/Hz.

5. Capable of operating induction and permanent magnet motors.
6. Economizer Mode:
    a. An auto economizer feature shall be available to automatically reduce the output voltage when the drive is operating in an idle mode (drive output current less than programmed motor FLA). The voltage shall be reduced to minimize flux current in a lightly loaded motor thus reducing kW usage.
    b. When the load increases, the drive shall automatically return to normal operation.
7. Flying Start: Ability to determine speed and direction of a spinning motor, and adjust drive output to “pick-up” the rotating motor (forward or reverse rotation).

M. Output filtering: Provide a 3 percent line reactor DV/DT output filter as required for motor protection, when indicated on the Drawings. Output filter shall be a standard accessory furnished by the VFD manufacturer.

N. Protection: The VFD shall have, as a minimum, the following protection features:
1. Branch Circuit Protection: Input fusing shall be provided as specified by the manufacturer.
2. Overload Protection
    a. The drive shall provide internal class 10 adjustable overload protection.
    b. Overload protection shall be speed sensitive and adjustable.
3. Input phase-to-phase and phase-to-ground line protection provided with metal oxide varistor (MOV) and RC network.
4. Protection against single phasing.
5. Instantaneous overcurrent protection.
6. Electronic overcurrent protection.
7. Ground fault protection.
8. Over-temperature protection for electronics.
9. Protection against internal faults.
10. Capability to monitor embedded winding temperature sensors for thermal protection and control of winding heaters.
11. Additional protection and control as indicated and as required by the motor and driven equipment.

O. Motor Winding Heating
1. Provide DC current to select windings when motor is not energized.
2. Power supply to be derived from pump supply.

P. Control Power:
1. Provide a control power transformer mounted and wired inside of the drive system enclosure. The transformer shall be rated for the VFD power requirements.
2. Provision for external 24V DC Auxiliary Control Power Supply.

Q. Operator Interface: The drive shall have an operator interface with backlit LCD and graphics display capability, and full numeric keypad. The operator interface shall be accessible from the front of the enclosure without opening any doors, and include the following features

1. Shall indicate drive operating conditions, adjustments and fault indications.
2. Shall be configured to concurrently display in a single screen:
   a. Status of direction, drive condition, fault / alarm conditions and Auto / Manual mode.
   b. Drive output frequency.
3. Shall provide digital speed control.
4. Keypad with programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.

R. Door-Mounted Controls:

1. Hand/Off/Auto Selector Switch
   a. Provide a "Hand/Off/Auto" selector switch, mounted on the enclosure door.
   b. The "Hand/Off/Auto" selector switch shall start the drive in the “Hand” mode and stop the drive in the “Off” mode.
   c. 3. In the “Auto” mode, the drive shall be started and stopped from a remote “RUN” contact.
2. Drive Disable Mushroom Push Button: Provide a maintained mushroom style push button, mounted on the enclosure door that when pushed, will open the drive enable input.
3. Pilot Lights: Provide LED pilot lights, mounted on the enclosure door, for indication of the following status:
   a. Run
   b. Drive Fault
   c. Control Power On
   d. Motor Fault
4. Motor Run Time Meter: Provide a digital, non-resettable, door-mounted elapsed time meter. The meter shall be electrically interlocked with the Drive Run relay and Bypass contactor to indicate actual motor operating hours.

S. Communications: Built-in managed dual EtherNet/IP ports for direct network connections, allowing linear or Device Level Ring (DLR) topologies. The same network for control must support safety, I/O, and motion control, as well as be able to switch using standard unmodified Ethernet networking equipment.

T. Terminal Blocks

1. For drives rated 250 Hp and larger, power wiring is landed on robust brackets behind the drive unit. This wiring remains in-place if the drive unit is removed.
2. Terminal blocks shall be provided for control wiring on all frames.
3. I/O terminal blocks shall be removable with wiring in place.

4. I/O control terminal blocks shall be rated for 115V AC.

2.4 SERVICE CART

A. Service cart accessory for lifting and moving large VFD roll-out internal modules. Provide one (1) service cart for the project where VFD roll-out modules are installed.

2.5 SPARE PARTS

A. The Contractor shall furnish the spare parts listed below, suitably packaged and labeled with the corresponding equipment number.

B. The following spare parts shall be furnished:
   1. Three (3) sets of spare fuses of each size.
   2. One (1) spare keypad access device (HIM).

PART 3 - EXECUTION

3.1 SERVICES OF MANUFACTURER

A. General: An authorized service representative of the manufacturer shall be present at the sites as necessary to furnish the inspection, startup, and field adjustment services listed below.

B. Inspection, Startup, Field Adjustment: The authorized service representative shall supervise the following and certify the equipment and controls have been properly installed, aligned, and readied for operation.
   1. Installation of the equipment
   2. Inspection, checking, and adjusting the equipment.
   3. Startup and field testing for proper operation
   4. Performing field adjustments such that the equipment installation and operation comply with requirements.

C. Instruction of Owner's Personnel: The authorized representative shall instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with test equipment. Instruction shall be specific to the VFD models provided.

D. Telephone Support: The drive Manufacturer shall provide one (1) year of telephone technical support for the Owner during normal business hours. The technical support shall include the drive, HIM, and Devicenet, and shall start on the date of substantial completion.

3.2 INSTALLATION

A. Conduit stub-ups for interconnected cables and remote cables shall be located and terminated in accordance with the drive manufacturer's recommendation.

B. Drives shall be mounted a minimum of 1-1/2 inches from any wall surface.

C. Strut supports for drives shall not be mounted directly to wood surfaces. Install ½-inch thick cement board (Dura-rock or equal) to the wood surface, a minimum of 2 inches larger than the drive outline all around.

D. The Contractor shall perform programming of drive parameters required for proper operation of the VFD's included in this project. Submit records of programming data in the equipment Technical Manual, including setup and protective settings

3.3 FIELD TESTING

A. Testing, checkout, and startup of the VFD equipment in the field shall be performed under the technical direction of the manufacturer's service engineer. Under no circumstances shall any portion of the drive system be energized without authorization from the manufacturer's representative.

END OF SECTION

SECTION 26 33 53 – STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. Furnish and install uninterruptible power supply systems in accordance with these specifications and the Contract Documents. The uninterruptible power supply systems, hereafter referred to as the UPS, shall be modular solid-state equipment designed to provide continuous-duty high-quality 3-phase AC power. The UPS shall be an approved power supply for emergency lighting.

1.2 REFERENCE STANDARDS

A. The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.
   1. CSA 22.2, No. 141 – Emergency Lighting Equipment
   2. FCC Part 15, Sub Part J, Class A – Radio Frequency Devices
   3. IEEE C62.41, Category A & B - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
   4. IEEE 1184 - Guide for the Selection and Sizing of Batteries for Uninterruptible Power Systems.
   5. NEMA PE-I - Uninterruptible Power Systems (UPS)
   6. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   7. NEMA PE 1 - Uninterruptible Power Systems.
   8. NETA ATS - Acceptance Testing Specifications for Electrical Power. Distribution Equipment and Systems.
   9. NFPA 70 - National Electrical Code (NEC)
   10. UL 924 – Safety Standard for Emergency Lighting and Power Equipment
   11. UL 1778 – Safety Standard for Uninterruptible Power Systems

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6.

B. Product Data:
   1. Catalog and technical data to indicate electrical characteristics, operating logic, short circuit ratings, topology, battery provisions, backuptime, and enclosure details.
   2. Shop drawings to indicate:
      a. Detailed dimensions and clearances for UPS, maintenance bypass, and battery cabinets.
      b. Weight and anchorage requirements.
      c. Power and grounding connections.

d. Single-line diagram to indicate metering, control, and external wiring connections.
Interconnections between cabinets.
e. Heat rejection and airflow requirements

C. Manufacturer's Field Reports: Indicate inspections, findings, and recommendations.

D. Operation and Maintenance Data: Submit description of operating procedures; servicing procedures; list of major components; recommended remedial and preventive maintenance procedures; and spare parts list.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Product Basis of Design: Vertiv / Liebert EXM UPS.

2.2 SYSTEM DESCRIPTION

A. General:
1. UPS shall be modular, with appropriate number of modules for capacity and/or redundancy. All modules are to be operating simultaneously and sharing the load. In a non-redundant system, all the modules making up the UPS are required to supply the full rated load. If a power or control module should malfunction, the load is to be transferred automatically to the bypass line. If a battery module should malfunction, it is to be isolated from the system resulting in reduced back up time. For redundant operation, the UPS will have one or more modules than what is required to supply the full rated load. The malfunction of one of the modules shall cause that module to be isolated from the system and the remaining module(s) shall continue to carry the load. Replacement of a module shall be capable without disturbance to the connected load.

2.3 PERFORMANCE REQUIREMENTS

A. UPS Configuration:
1. Non-redundant, single-module, true-on-line double conversion, reverse transfer power supply system.
2. Single AC input source, 3-phase, grounded WYE, 3-wire + ground.
3. Integral overcurrent protection devices:
a. Bypass Isolation Breaker (BIB)
b. Maintenance Bypass Breaker (MBB)
c. Maintenance Isolation Breaker (MIB)
d. Battery Disconnect Breaker
4. Power rating shall be upgradable within the frame size of the UPS.
5. Remote Stop: The UPS shall include provisions for remote stop capability.

B. Power Rating:
   1. 10 kW output (unity load power factor rating) in a 40kVA frame size.
   2. Scalable output from 10kVA to 40kVA in increments (10 to 15, 20, 30, and 40 kVA) with firmware and hardware upgrade.

C. Battery Capacity:
   1. Batteries (internal + external cabinet) shall support the UPS at 100% rated kW load for at least 90 minutes at 77°F (25°C) at startup.

D. AC Input:
   1. Voltage Configuration: 208VAC, three-phase, four-wire plus ground
      a. Rectifier input, Bypass input
   2. Voltage Range: +20%, -15% at full load; -40% at half load
   3. Frequency Range: 40 - 70Hz
   4. Input Current Distortion: Less than or equal to 5% input current THDi at full load input current in double-conversion mode (nominal input voltage, <1% input voltage THDv, and <1% input voltage imbalance)
   5. Input Power Factor: Minimum 0.99 at full load with nominal input voltage
   6. Inrush Current: Not to exceed 1.5 times rated input current
   7. Input Current Walk-In: The UPS shall contain a controlled module walk-in to minimize inrush current upon auto-restart. The module walk-in is programmable for a 1 to 5 second delay.
   8. Surge Protection: Sustains input surges of 6kV without damage per criteria listed in IEEE C62.41, Category A, Level 3 and Category B, Level 3 and per IEC/EN/AS 61000-4-2, 3, 4, 5, 6 Category 2
   9. Short Circuit Current Rating: 65kA Short Circuit Withstand Rating.

E. AC Output:
   1. Voltage Configuration: 208VAC, three-phase, four-wire plus ground
   2. Voltage Regulation
      a. ±1% RMS average for a balanced, three-phase load
      b. ±5% for 100% unbalanced load for line-to-line imbalances
   3. Frequency Regulation: 50 or 60Hz, ±0.05% free running
   4. Frequency Slew Rate: 0.1 to 3 Hz/sec, 0.6 Hz/sec default setting
   5. Bypass Frequency Synchronization Range: ±0.5, 1.0, 2.0, 3.0 Hz, adjustable by factory service personnel, ±2.0 Hz default setting
   6. Voltage Distortion: 1% total harmonic distortion (THD) maximum into a 100% linear load, 3% THD maximum into a 100% non-linear load with crest factor ratio of 3:1
   7. Load Rating: 100% of load rating at 104°F (40°C) for any load from 0.5 lagging to 0.9 leading
   8. Overload Capability: at Full Output Voltage with ±1% voltage regulation
      a. 100% continuously
      b. 105% - 110% of full load for 60 minutes (40°C) ambient
      c. 110% - 125% of full load for 10 minutes (40°C) ambient
      d. 125% - 150% of full load for 60 seconds (40°C) ambient
      e. >150% of full load for a minimum of 200 milliseconds (40°C) ambient
      f. Load shall be transferred to bypass when any of the above conditions are exceeded.
      g. UPS shutdown: After 2 cycles if > 201%. Immediate for short circuit.

9. Load Rating: 100% of load rating at 104°F (40°C) for any load from 0.5 lagging to 0.9 leading.
10. Voltage Adjustment Range: ±5% for line drop compensation adjustable by factory service personnel.

2.4 DESIGN REQUIREMENTS

A. Architecture:
1. The UPS output capacity shall have the option to enable scalability at the time of ordering and shall be upgradable by the Manufacturer.
2. The UPS shall have the option to configure the 10-180kVA system for N+1 internal redundancy at the time of order.
3. The UPS shall be able to supply all required power to full rated output kVA loads with power factor from 0.5 lagging to 0.9 leading. The UPS shall also work from unity power factor to 0.5 leading power factors subject to derating.
4. The AC input source and bypass input source shall each be a solidly grounded wye service.
5. The rectifier AC input and bypass AC input may be fed from separate AC sources with the use of an optional Transformer Cabinet.
6. The UPS shall have an active power factor-corrected IGBT converter/rectifier, capable of maintaining input power factor and input current total harmonic distortion (THDi) within specifications without an additional input filter.
7. The UPS shall be of transformer-free design, requiring no internal transformer in the main power path for the basic operation of the module. Optional transformers in cabinets or otherwise external to the basic UPS module shall be permissible to provide isolation and/or voltage transformation

B. Modes of Operation: The UPS shall operate as an on-line reverse transfer system in the following modes:
1. Normal: The critical AC load shall be continuously powered by the UPS inverter. The rectifier/charger shall derive power from the utility AC source and supply DC power to the DC-DC converter, which in turn shall supply the inverter while simultaneously float charging the battery.
2. ECO Mode: The critical AC load shall be continuously powered by the bypass with the inverter available to power the load if the bypass source voltage or frequency exceeds adjustable parameters of power quality.
3. Battery: Upon failure of utility AC power, the critical load shall be powered by the inverter, which, without any switching, shall obtain its power from the battery plant via the DC-DC converter. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.
4. Recharge: Upon restoration of the utility AC source, the rectifier shall supply power to the output inverter and to the DC-DC converter, which shall simultaneously recharge the batteries. This shall be an automatic function and shall cause no interruption to the critical load.
5. Bypass: If the UPS must be taken out of service, the static transfer switch shall transfer the load to the bypass source. The transfer process shall cause no interruption in power to the critical load.
6. Maintenance Bypass: An optional external wrap-around maintenance bypass shall be used to ensure full isolation of the unit for the service of internal

components while providing safety from arc flash and in compliance with OSHA requirements.

7. Off-Battery: If only the battery is taken out of service, it shall be disconnected from the DC-DC converter by means of an external disconnect circuit breaker (in the case of external batteries). The UPS shall continue to function and meet all the specified steady-state performance criteria, except for the power outage backup time capability. If multiple battery strings are used, each string shall be capable of being electrically isolated for safety during maintenance.

2.5 DISPLAY AND CONTROLS

A. UPS Control Panel: The UPS shall be provided with a microprocessor-based control panel for operator interface (may also be referred to as User Interface, or UI) to configure and monitor the UPS. The control panel shall be located on the front of the unit where it can be operated without opening the hinged front door. A backlit, menu-driven, full-graphics, color touchscreen liquid crystal display shall be used to enter setpoints for the battery test (duration and end voltage), display system information, metering information, a one-line diagram of the UPS and battery, active events, event history, startup instructions and transfer and shutdown screens.

1. No mechanical push buttons shall be used.

B. Logic: UPS system logic and control programming shall reside in a microprocessor-based control system with nonvolatile flash memory. Rectifier, inverter and system control logic shall utilize high-speed digital signal processors (DSPs). CANbus shall be used to communicate between the logic and the User Interface as well as the options. Switches, contacts and relays shall be used only to signal the logic system as to the status of mechanical devices or to signal user control inputs. Customer external signals shall be isolated from the UPS logic by relays or optical isolation.

C. Metered Values: A microprocessor shall control the display and memory functions of the monitoring system. All three phases of three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accuracy to ±3% of voltage, ±5% AC current. The following parameters shall be displayed:

1. Input voltage, line-to-line
2. Input current per phase
3. Input frequency
4. Input apparent power (kVA)
5. Battery voltage
6. Battery charging/discharging current
7. Output voltage, line-to-line
8. Output frequency
9. Bypass input voltage, line-to-line
10. Bypass input frequency
11. Load current
12. Load real power (kW), total and percentage
13. Load apparent power (kVA), total and percentage
14. Load percentage of capacity
15. Battery temperature, each battery string

16. Battery state of charge

D. Power Flow Indications: A power flow diagram shall graphically depict whether the load is being supplied from the inverter, bypass or battery and shall provide, on the same screen, the status of the following components:
   1. AC Input Circuit Breaker (optional)
   2. Battery Circuit Breaker, each breaker connection of complete battery complement, complete disconnection and partial connection (one or more, but not all breakers open.)
   3. Maintenance Bypass Status

E. Main Display Screen—The following UPS status messages shall be displayed:
   1. Rectifier (Off / Soft Start / Main Input On / Battery Input On)
   2. Input Supply (Normal Mode / Battery Mode / All Off)
   3. Battery Self Test (True / False)
   4. Input Disconnect (Open / Closed)
   5. EPO (True / False)
   6. Charger (On / Off)
   7. Output Disconnect (Open / Closed)
   8. Maint. Disconnect (Open / Closed)
   9. Bypass Disconnect (Open / Closed)
   10. Inverter (Off / Soft Start / On)
   11. Bypass (Normal / Unable To Trace / Abnormal)
   12. Output Supply (All Off / Bypass Mode / Inverter Mode / Output Disable)
   13. Inverter On (Enable / Disable)

F. HMI Control Buttons: Buttons shall be provided to start and stop the inverter. A pop-up message requesting confirmation shall be displayed whenever a command is initiated that would change the status of the UPS.
   1. Other buttons shall be provided to reset faults and silence the alarm buzzer.

G. Event Log: This menu item shall display the list of events that have occurred recently while the UPS was in operation. The Event Log shall store up to 2048 events, with the oldest events being overwritten first if the log's capacity is reached.

H. Battery Status Indicator: A battery status indicator shall display DC alarm conditions, temperature, battery state of charge, the present battery voltage, total discharge time, status of last battery test and battery time remaining during discharge.

I. The UPS shall provide the operator with controls to perform the following functions:
   1. Configure and manage manual battery test
   2. Modify test duration and minimum voltage
   3. Start battery test
   4. Monitor test status and progression
   5. Stop battery test
   6. Battery test status

J. Alarms—The following alarm messages shall be displayed:
   1. Mains Voltage Abnormal
   2. Mains Undervoltage

3. Mains Freq. Abnormal
4. Charger Fault
5. Battery Reversed
6. No Battery
7. Parallel Comm. Fail
8. Bypass Unable To Track
9. Bypass Abnormal
10. Inverter Asynchronous
11. Fan Fault
12. Control Power Fail
13. Unit Overload
14. System Overload
15. Bypass Phase Reversed
16. Transfer Time-Out
17. Load Sharing Fault
18. Bypass Over Current.

K. Controls—System-level control functions shall be:
1. Start Inverter (and transfer to inverter)
2. Stop Inverter (after transferring to bypass)
3. Startup Screen
4. Battery Test Setpoint Adjustment
5. Configure Manual Battery Test
6. Initiate Manual Battery Test
7. System Settings (Time, Date, Language, LCD Brightness, Password, Audio Level)
8. Alarm Silence Command
9. Fault Reset Command
10. ECO mode

L. Manual Procedures: Load Transfers: HMI buttons (START INVERTER, STOP INVERTER) shall provide the means for the user to transfer the load to bypass and back on UPS.

M. Self-Diagnostics
1. Event Log File - The control system shall maintain a log of the event conditions that have occurred during system operation. Each log shall contain the event name, event time/date stamp and a set/clear indicator.

N. Output Alarm Contacts: Dry contact outputs shall be provided for Summary Alarm, Bypass Active, Low Battery and AC Input Failure.

O. Customer Input Contacts:
1. The UPS shall have four discrete input contacts available for the input and display of customer-provided alarm points or to initiate a pre-assigned UPS operation. Each input can be signaled by an isolated, external, normally open contact.
2. When an assembly is selected as a pre-assigned UPS operation, the following actions shall be initiated:

a. On Generator—Provides selectable choices to enable or disable battery charging, and enable or disable ECO Mode operation while on generator.
b. Transfer to Bypass—Manual command to transfer from inverter operation to static bypass operation.
c. Fast Power Off—Emergency Module Off (EPO) command to stop UPS operation.
d. Acknowledge Fault—Acknowledge a UPS alarm condition and present faults will be reset.
e. Bypass/Inverter Off—Emergency Power Off (EPO) command to stop UPS operation.
f. External Maintenance Bypass Breaker (MBB) status (open or closed)

2.6 UPS CABINET

A. Fabrication:
1. NEMA 250, Type 1 enclosure allowing access from front for servicing adjustments and connections.
2. Access through hinged door equipped with tumbler lock and latch handle. Equip cabinet for hoisting, jacking, and fork truck handling.
3. Front doors enable safe change of air filters without the need for shutdown.

B. Electroplate brackets and securing hardware with corrosion resistant material. Secure bolts, studs and nuts with lock washers.

C. Identify internal wiring at each end of conductor. Furnish cabinet grounding lug.

D. Cabinet finish: Primed and painted inside and outside with suitable semi-gloss enamel.

2.7 MAINTENANCE BYPASS CABINET

A. The UPS system shall incorporate a matching cabinet to house a wraparound maintenance bypass with three circuit breakers for complete electrical isolation of the UPS with system voltage: 208/120 VAC, 4W+Gnd input/output.

2.8 BATTERY PLANT

A. The UPS system shall be provided with a valve-regulated, lead acid battery plant.
1. The batteries shall be fully charged per the manufacturer's instructions during startup and shall demonstrate the specified operating time.

B. Matching Battery Cabinet
1. The battery cabinet shall consist of sealed, valve-regulated batteries, a circuit breaker for isolating the battery from the UPS and a control interface to the UPS module.
2. The battery cabinet shall be rated NEMA 1, matching the UPS style and design.
3. Battery Isolation Circuit Breaker: The circuit breaker shall be sized to allow discharge at the maximum published rating of the battery. The interface to the

UPS module shall provide status and thermal data to allow the UPS to regulate the charging voltage and inhibit the conditions associated with battery thermal runaway. If the temperature measurement in a battery cabinet indicates that thermal runaway is occurring, then the UPS controls shall isolate the cabinet from the charger by tripping the battery breaker in that cabinet while leaving the other battery cabinets connected to allow UPS operation during a loss of power to the rectifier.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.22.

C. Verify specification performance criteria.

D. Measure battery discharge and recharge times.

E. Simulate fault in each system component and utility power.

F. Operate unit at 77 degrees F (25 degrees C) for eight hours.

G. Perform other tests as recommended by manufacturer.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start up UPS.

B. Furnish four hours of instruction each for Owner personnel, to be conducted at project site with manufacturer's representative.

END OF SECTION

SECTION 26 36 23 – AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. Furnish and install automatic transfer switches with bypass-isolation provisions, number of poles, amperage, voltage, and withstand ratings as specified herein. Each automatic transfer switch shall consist of a delayed transition transfer switch, a two-way bypass/isolation switch, and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

1.2 REFERENCE STANDARDS

A. The automatic transfer switches and controls shall conform to the requirements of:
   1. UL 1008 - Standard for Transfer Switch Equipment
   2. IEC 947-6-1 Low-voltage Switchgear and Controlgear; Multifunction equipment; Automatic Transfer Switching Equipment
   3. NFPA 70 - National Electrical Code
   4. NFPA 99 - Essential Electrical Systems for Health Care Facilities
   5. NFPA 110 - Emergency and Standby Power Systems
   6. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
   7. NEMA Standard ICS10-1993 (was ICS2-447) - AC Automatic Transfer Switches
   8. UL 508 Industrial Control Equipment

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6.

B. Product Data:
   1. Catalog data showing voltage, switch ratings, operating logic, short circuit ratings, dimensions, and enclosure details.
   2. Shop drawings to indicate:
      a. Dimensions and required clearances.
      b. Weight and anchorage requirements.
      c. Terminal lug arrangement and conductor capacity.
   3. Wiring diagrams.

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER AND BYPASS / ISOLATION SWITCH

A. Manufacturer: ASCO 7000 Series or equal.

B. Product Description:
   1. NEMA ICS 10, automatic transfer switch (ATS) with manual bypass switch.
   2. Delayed Transition Switching: ATS shall transfer the load in delayed transition (break-before-make) mode. Transfer is accomplished with a user-defined load disconnect period in both directions adjustable from 1 second to 5 minutes in at least 15 increments.

C. Configuration: Draw-out type electrically-operated, mechanically-held transfer switch with manually-operated CONNECTED, TEST, AND DISCONNECTED draw-out positions, and with mechanically-operated, mechanically-held transfer switch connected to bypass automatic switch in both NORMAL and EMERGENCY positions.

D. Rating:
   1. ATS: 1600 A, 480/277 VAC, 3-phase, 4-wire, 4-pole with switched neutral, as indicated on Drawings.
   2. Bypass Switch: Match ATS for electrical ratings.
   3. 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 as determined from Section 26 05 73 - Protective Device Studies.
      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.

2.2 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch unit shall be electrically operated and mechanically held. The electrical operators shall be a solenoid mechanism, momentarily energized. The transfer switch unit shall include both electrical and mechanical interlocks to prevent both sets of main contacts from being closed at the same time. Main operators which include overcurrent disconnect devices OR do not include electrical and mechanical interlocks will not be accepted.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

D. All main contacts shall be silver composition. Switches rated 800 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 800 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

F. 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.

G. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

2.3 BYPASS-ISOLATION SWITCH

A. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

B. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.

C. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.

D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.

E. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.

G. Designs requiring operation of key interlocks for bypass isolation or ATS which cannot be completely withdrawn when isolated are not acceptable.

2.4 MICROPROCESSOR CONTROLLER

A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to □ 1% of nominal voltage. Frequency sensing shall be accurate to □ 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

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. Sensing and control logic shall be provided on multi-layer printed circuit boards. 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 for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.

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:
      a. EN 61000-4-2:1995 — Electrostatic discharge (ESD) immunity
      b. ENV 50140: 1993 — Radiated Electro-Magnetic field immunity
      c. EN 61000-4-4:1995 — Electrical fast transient (EFT) immunity
      d. EN 61000-4-5:1995 — Surge transient immunity
      e. EN 61000-4-6:1996 — Conducted Radio-Frequency field immunity
   3. IEEE472 (ANSI C37.90A) Ring Wave Test.

2.5 ENCLOSURE:

A. The ATS shall be furnished in a Type 1 enclosure.

B. All standard and optional door-mounted switches and pilot lights shall be 16-mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate.

C. A pressure disconnect link shall be provided to disconnect the normal source neutral connection from the emergency and load neutral connections for 4-wire applications. A ground bus shall be provided for connection of the grounding conductor to the grounding electrode. A pressure disconnect link for the neutral to ground bonding jumper shall be provided to connect the normal neutral connection to the ground bus.

2.6 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.

2.7 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):

Parameter	Sources	Dropout / Trip	Pickup / Reset
Undervoltage	N&E,3ϕ	70 to 98%	85 to 100%
Overvoltage	N&E,3ϕ	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.

2.8 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.

F. The controller shall also include the following built-in time delays for Delayed Transition & Bypass-Isolation operation:
   1. 0 to 5 minute time delay for the load disconnect position for delayed transition operation.

2.9 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. 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.

F. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines.

G. System Status - The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position.

H. 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.

I. 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 controller is energized.
   d. Total number of hours both normal and emergency sources are available.

J. Communications Interface: The controller shall be capable of interfacing through an optional serial communication module.

PART 3 - EXECUTION

3.1 QUALITY ASSURANCE TESTING

A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements. Submit certified record of factory testing when ATS is ready to be shipped from factory.

3.2 INSTALLATION

A. Install housekeeping pads as specified in Section 26 05 00 – Electrical Work, General.

B. Install engraved nameplates as specified in Section 26 05 00 – Electrical Work, General.

3.3 FIELD QUALITY CONTROL

A. Provide Manufacturer's field services to perform field inspection, testing, adjusting, and balancing.
   1. Inspect and test in accordance with NETA ATS, except Section 4.
   2. Perform inspections and tests listed in NETA ATS, Section 7.22.3.
   3. Check out transfer switch connections and operations and place in service.
   4. Adjust control and sensing devices to achieve specified sequence of operation.

3.4 DEMONSTRATION AND TRAINING

A. Demonstrate operation of transfer switch in bypass, normal, and emergency modes

END OF SECTION

SECTION 26 43 13 – SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide Surge Protective Devices, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCES STANDARDS

A. UL 1449 3rd Edition.

B. UL 1283.

C. ANSI/IEEE Standard C62.41.1.

D. ANSI/IEEE Standard C62.45.

E. ANSI/NFPA 70 – National Electrical Code.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6, and 26 05 00 – Electrical Work, General.

B. Product Data: Submit product data for all components provided, showing electrical characteristics and connection requirements. Each catalog sheet should be clearly marked to identify the exact part number provided.
   1. Verify surge protective devices comply with UL 1449 and IEEE C62.41.1 standards.

C. Shop Drawings: Provide enclosure and support point dimensions, voltage, surge current per phase, surge current per mode and performance characteristics.

D. Test Reports: Provide third party test reports in compliance with NEMA LS1 from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on both a per mode and per phase basis using the IEEE C62.42, 8 x 20 microsecond current wave.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Product specified is based on Square D/ Schneider Electric Surgelogic EMA series surge protective device. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Engineer will be the sole judge of the basis for proposed equivalent products.

2.2 SURGE PROTECTIVE DEVICES

A. SPDs: Comply with UL 1449.
   1. SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs.
   2. SPDs installed on the load side of the service entrance disconnect shall be either Type 1 or Type 2 SPDs. Type 2 SPDs shall also comply with UL 1283.

B. Surge Protective Devices shall include the following features:
   1. ANSI/UL 1449 Listed.
   2. Warranty: Ten years.
   3. Integral cover-mounted disconnecting means.
   4. Modular design (with field-replaceable modules).
   5. Fuses, rated at 200-kA interrupting capacity.
   6. Minimum ANSI/UL 1449 withstand (In) rating to be 20kA per mode
   7. Tested with the ANSI/IEEE Category CHigh exposure waveform (20kV-1.2/50•s, 10kA-8/20•s).
   8. Pulse life test: Capable of protecting against and surviving 20,000 ANSI/IEEE Category C, high transients without failure or degradation of clamping voltage by more than 10%.
   9. Bolted compression lugs for internal wiring.
   10. Coordinated thermal and surge current fusing.
   11. Redundant suppression circuits.
   12. Replaceable modules, 1 per phase minimum.
   13. LED indicator lights visible on equipment cover for power and protection status.
   14. Audible alarm, with silencing switch, to indicate when protection has failed.
   15. Form-C contacts rated at 2 A and 24-V ac minimum, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
   16. Six-digit transient-event counter set to totalize transient surges.
   17. Maximum Continuous Operating Voltage (MCOV) shall be greater than 115% of the nominal system operating voltage (L-G).

C. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistor (MOV) surge suppressor. The suppression system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage.

D. Surge Current Rating: Minimum surge current capability (single-pulse rated) shall be 240 kA per phase (120 kA per mode) for the service entrance and 160 kA per phase (80 kA per mode) for distribution panels. The suppressor shall have a 10 kA Surge Withstand Capability in accordance with NEMA LS 1 and ANSI/IEEE C62.42.

E. Protection Modes: For a wye configured system, the device shall have directly connected suppression elements between line and neutral (L-N), line and ground (L-G), and neutral and ground (N-G). For a delta configured system, the device shall have suppression elements between line to line (L-L) and line to ground (L-G).

F. Voltage Protection Rating (VPR): The maximum UL 1449 (IEEE C62.42 Cat. 6kV, 500A) VPR for grounded WYE configured SPDs shall not exceed the following:

Modes	480Y/277
L-N; L-G; N-G	1200 V
L-L; L-G	2000 V

2.3 ENCLOSURES

A. Enclosure shall meet or exceed the ratings for the environment to be installed as indicated on Drawings.
   1. SPDs mounted indoors shall be provided with a NEMA 250, Type 3R/12 enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install SPD's in accordance with manufacturer's instructions.

B. Provide a circuit breaker disconnect for the TVSS, sized per manufacturer requirements.

C. All SPD monitoring diagnostics features, such as indicator lights, trouble alarms, etc., shall be visible on the dead-front.

3.2 FIELD QUALITY CONTROL

A. Section 26 01 26 – Testing and Maintenance of Electrical Systems: Field inspection and testing.

B. Inspect and test in accordance with manufacturer's written instructions.

C. Verify wiring connections are tight.

END OF SECTION

SECTION 26 50 00 – LIGHTING

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide lighting fixtures, supports, and lamps, and accessories, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. If the CONTRACTOR proposes to install equivalent equipment to that suggested, then he shall furnish the following product information in accordance with MASS Section 10.05 Article 5.6.
   1. Interior luminaires
      a. Catalog data sheets and pictures.
      b. Luminaire finish and metal gauge.
      c. Lens material, pattern, and thickness.
      d. Candle power distribution curves in two or more planes.
      e. Candle power chart 0 to 90 degrees.
      f. Lumen output chart.
      g. Average maximum brightness data in foot lamberts.
      h. Coefficients of utilization for zonal cavity calculations.
      i. Mounting or suspension details.
      j. Heat exchange and air handling data.
   2. Exterior luminaires
      a. Catalog data sheets and pictures.
      b. Luminaire finish and metal gauge.
      c. Lens material, pattern, and thickness.
      d. IES lighting classification and isolux diagram.
      e. Fastening details to wall or pole.
      f. Ballast type, location, and method of fastening.
      g. For light poles, submit wind loading, complete dimensions, and finish.
   3. Lamps
      a. Voltages (120V Only).
      b. Colors.
      c. Approximate life (in hours).
      d. Approximate initial lumens.
      e. Lumen maintenance curve.
      f. Lamp type and base.
   4. Ballasts
      a. Type.
      b. Wiring diagram
      c. Nominal watts and input watts.

d. Input voltage (120V unless with special permission) and power factor.
e. Starting current, line current, and restrike current values.
f. Sound rating.
g. Temperature rating.
h. Efficiency ratings.
i. Low temperature characteristics.
j. Emergency ballasts rating and capacity data.

PART 2 - PRODUCTS

2.1 FIXTURES - GENERAL

A. Luminaires: Specific requirements relative to execution of WORK of this Section are located in the Luminaire Schedule on Contract Drawings.

B. All fixtures shall be pre-wired with leads of 18-AWG, minimum, for connection to building circuits.

2.2 EXTERIOR FIXTURES

A. Exterior fixtures in combination with their mounting pole and bracket shall be capable of withstanding 100 MPH winds without damage. Exterior fixtures shall have corrosion-resistant hardware and hinged doors or lens retainer. Fixtures specified to be furnished with integral photo-electrical control shall be of the fixture manufacturer's standard design.

2.3 INTERIOR FIXTURES

A. Interior fixtures without diffusers shall be furnished with end plates. Where diffusers are required, they shall be of high molecular strength acrylic. Minimum thickness of the acrylic shall be 0.125 inches for all diffusers, except that those on 4-foot square fixtures shall be 0.187 inches thick.

B. Emergency Exit Signs
1. Internally illuminated.
2. Universal mounting type.
3. Power supply:
   a. Self-contained type, unless otherwise scheduled on Drawings:
      1) Internal 6-volt nickel cadmium battery, 90 minutes capacity to emergency lamps.
      2) Two-rate regulated battery charger to minimize energy consumption. Filtered charger output to minimize voltage ripple and extend battery life. Thermal protection and current-limiting charger circuitry to prevent overheating and charger failure.
      3) Press to test button.
4. 19,000 hours expected lamp life.

5. Directional arrows.
6. Red letters on a white panel, 6 inches high.

C. LED Luminaires:
1. Luminaires shall be listed for locations as scheduled in the Drawings.
2. Luminaires shall have a five-year warranty, minimum, for the LEDs and the driver.
3. Initial lumen output of the fixture shall meet or exceed those scheduled in the Drawings.
4. Average delivered lumens over 50,000 hours shall be a minimum of 85% of initial delivered lumens.
5. LED module elements shall be wired in series parallel strings. The failure of one LED, and its associated string of LEDs, shall not cause the loss of more than 20% of the light output of the complete LED module.
6. Driver power factor shall be 0.9 or greater.
7. Driver total harmonic distortion (THD) shall be 20% or less.
8. Submit current electronic photometric data in Illuminating Engineering Society (I.E.S.) format for all proposed substitutions.

2.4 LAMPS

A. Lamps shall be first-line **General Electric, Cutler-Hammer, Sylvania**, or equal.

2.5 PHOTO-ELECTRIC CELLS

A. Photoelectric cells for control of multiple fixtures shall be self-contained, weatherproof type, rated for 1800 va 120-volt, single pole, single throw, and shall be provided with time-delay features. Photoelectric cell shall be **Tork Model 5237-UL**, or equal.

2.6 EMERGENCY LIGHTING CONTROL DEVICES

A. Branch Circuit Emergency Lighting Transfer Switch:
1. A UL 1008 listed device that switches between two power sources to supply emergency lighting fixtures.
2. Voltage rating: 120-277 VAC, 50/60 Hz
3. Load rating: 20 A maximum, ballast or LED driver lighting loads.
4. Warranty: 5-year as a minimum.
5. Controls: Integral test switch, with normal and alternate power indicators.
6. Enclosure: suitable for indoor or damp locations. Mount in NEMA 12 enclosure as indicated on Drawings.
7. Manufacturer: Bodine GTD 20A, or an approved UL 1008 device substitution.

B. Emergency Lighting Control Relay:
1. A UL 924 listed device that monitors the normal power lighting circuit and upon failure of normal power the emergency lighting circuit will close to provide emergency lighting ON until normal power is restored.

2. Voltage rating: 120-277 VAC, 50/60 Hz
3. Load rating: 20 A maximum, ballast or LED driver lighting loads.
4. Warranty: 5-year as a minimum.
5. Controls: Integral test switch, with normal and alternate power indicators.
6. Enclosure: suitable for indoor or damp locations. Mount in NEMA 12 enclosure as indicated on Drawings.
7. Manufacturer: Bodine GTD 20A, or an approved UL 924 device substitution.

2.7 BALLASTS

A. Ballasts for fluorescent fixtures in indoor areas shall have a Class "A" sound rating. Such ballasts shall be of the low loss type. All ballasts shall be high power factor, Class P. Primary ballast voltage shall be suitable for use in the branch circuits indicated in the Contract Documents. All ballasts shall be UL-listed.

2.8 FIXTURE TYPES

A. Specific requirements are located in the Lighting Fixture Schedule on the Contract Drawings.

PART 3 - EXECUTION

3.1 LUMINAIRES

A. Install in accordance with manufacturer’s recommendations.

B. Provide necessary hangers, pendants, and canopies.

C. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building required to safely mount.

D. Install plumb and level.

E. Locate luminaires to avoid both conflict with other building systems and blockage of luminaire light output.

3.2 LAMPS

A. Provide in each fixture, the number and type for which the fixture is designed, unless otherwise indicated.

3.3 BALLASTS

A. Install in accordance with manufacturer’s recommendations.

B. Utilize all ballast mounting holes to fasten securely within luminaire.

C. Replace noisy or defective ballasts.

3.4 CLEANING FOLLOWING INSTALLATION

A. Remove all labels and other markings, except UL listing mark.

B. Wipe luminaires inside and out to remove construction dust.

C. Clean luminaire plastic lenses with antistatic cleaners only.

D. Touch up all painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

E. Replace all defective lamps at time of Substantial Completion.

END OF SECTION

SECTION 27 10 00 – STRUCTURED COMMUNICATIONS CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all materials and labor for the installation of a Structured Cabling Telecommunications System (SCTS) as shown on the Drawings and specified herein. The work shall include (but is not limited to) furnishing and installing all raceways, cabling, cable trays, boxes/enclosures, supports, equipment racks, outlets/jacks equipment, cable management, switches/routers, labeling, testing and all other related material, equipment and labor required for a complete and fully operational system. Major components of the system include:
   1. Horizontal cabling: conforming to EIA/TIA 568B (Category 6).
   2. Horizontal pathway: conforming to EIA/TIA 569, using raceways as indicated.
   3. Premises wiring: complete from distribution frames to each panel, device or outlet, using wire and cable as specified and that meets at least Category 6 standards.

B. The intent of this specification is to place in working order a complete, fully tested and documented Category 6 system complying with Codes and Standards referenced herein.

1.2 RELATED WORK

A. The work of the following Sections is related to the work of this Section. Other Sections, not referenced below, may also be related to this work. It is the Contractor's responsibility to perform all the work required by the Contract Documents.
   1. Division 26 – Electrical

1.3 REFERENCES

A. ANSI/NFPA 72 –National Electrical Code

B. EIA/TIA-568B – Commercial Building Telecommunications Cabling Standard

C. EIA/TIA-569 – Commercial Building Standard for Telecommunication Pathways and Spaces

D. EIA/TIA-606 – Administrative Standard for Telecommunication Infrastructure of Commercial Buildings

E. EIA/TIA-607 – Commercial Building Grounding and Bonding for Telecommunications

F. NECA/BICSI 568-2001 - Standard for Installing Commercial Building Telecommunications Systems

1.4 SUBMITTALS

A. Shop Drawings:
   1. Telecommunication Drawings:
      a. Show service entrance facility and layout of cabling and pathway routing, cross connect points, backboards, panels grounding system, terminating block arrangement and type.
      b. Depict telecommunications cabling configuration, including location, color coding, gauge, pair assignment, polarization, and terminating blocks layout at cross connect points, nodes and patch panels.
      c. Distribution Frames: Show layout of equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks and equipment spaces and racks.

B. Labeling System: Coordinate with Owner's labeling conventions. Submit Project labeling for approval.

C. Product Data:
   1. Telecommunication/LAN cabling (horizontal and backbone). Copper and fiber.
   2. Telecommunication/LAN connector assemblies, outlets, etc.
   3. Distribution Frame cabinets/racks and all associated equipment (patch panels, patch cables, cable management, UPS, etc.).
   4. Cable tray and associated hardware.
   5. Rack mounted electronic equipment. (switches, routers, etc.) .

D. Installer's Experience and Qualifications:
   1. Names and locations of two projects, of similar complexity, successfully completed using copper and fiber cabling systems.
   2. Specific experience installing and testing structured telecommunications distribution system using fiber optic and Category 6 cabling systems.

E. Manufacturer's Warranty as specified elsewhere in this Section, include all warranty provisions and procedures for Owner to follow to obtain warranty service.

F. Quality Assurance Test Plan, shall include as a minimum:
   1. A schedule of when test will be performed relative to project schedule.
   2. List of test equipment that will be used including manufacturer, model, calibration certification, range and resolution accuracy.
   3. Procedures for certification, validation and testing.
   4. Sample of test form to be used to record test results.
   5. Test Plan shall be submitted to the Owner for approval at least 30 days prior to the start of testing.
   6. Telecommunications system test report consisting printed test results from test equipment.

G. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Perform all Work in accordance with all regulatory rules and regulations including those referenced in this specifications.

B. Products shall be UL listed and shall comply with the NEC and EIA/TIA standards.

C. Perform all Testing in accordance with TIA/EIA-568B specification and submitted all printed reports.

1.6 QUALIFICATIONS

A. Submit documentation from the manufacturer that the products meet the requirements specified in this section.

B. Submit documentation demonstrating that the specialty contractor bidding this work will have only manufacturer-trained and certified installers performing installation and testing of the telecommunications system. The Contractor specializing in installing the products specified in this section shall have completed at least three projects equal to or larger in size than this project within the past five years.

C. Submit documentation demonstrating that the specialty contractor employs a minimum of one Registered Communications Designer (RCDD) certified by and in current good standing with BICSI. The document shall declare that the RCDD is a direct full time employee of the Contractor and that the Contractor will maintain a minimum of one RCDD throughout the duration of the project.

1.7 WARRANTY

A. The Contractor shall warrant that all materials and equipment furnished under the contract are in good working order, free from defects and in conformance with system specifications. All installed equipment must conform to the Manufacturer's official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of 12 months from that date. The Contractor shall agree to repair, adjust and/or replace (as determined by the Owner to be in its best interest) any defective equipment, materials or other parts of the system at the Contractor's sole cost. The Owner will incur no costs for service or replacement of parts during the warranty period of 12 months. All original Manufacturer or other third party warranties shall be passed through from Contractor to Owner.

B. All communications system components shall be rated for end-to-end system Category 6, or greater performance levels on all pair combinations and warranted to support the requirements of this specification.

PART 2 - PRODUCTS

2.1 TELECOMMUNICATION OUTLETS

A. General copper:

1. General: Optional jack configuration of each outlet, removable from the front with the faceplate mounted in place, and allow for the jack to pass through the faceplate without re-termination, insulation displacement blocks, color-coded snap-in icons, high impact, flame retardant thermoplastic, UL 1863 compliant.
2. Data information couplers, designed for termination of 4-pair balance twisted pair Category 6 copper cable, insulation displacement blocks, T568B wiring configuration.
3. Provide (2) telephone and (2) data RJ45 jacks for each outlet.
4. Color shall match wall finishes.

B. Manufacturers: Siemens or equal.

2.2 FACEPLATES

A. Workstation faceplates: Faceplates shall permit installation of copper couplers, allow couplers to be removed from the front of the faceplate, allow UTP couplers to pass through faceplates even after termination, Communications Circuit Accessory Listed per Underwriters Laboratory Standard UL 1863. Color shall match room finishes.

B. Identification: Each faceplate will be machine labels with indication for both voice and data. Each cable will be labeled with the same identification behind the jack in the 4s deep box. Labels for each cable termination and jack will be provided by the Contractor and coordinated/approved by Owner in advance, see Submittals.

2.3 PATCH CORDS

A. Unshielded twist pair (UTP) data: All Category 6 modular equipment cords shall be 100% transmission tested with laboratory grade network analyzers for proper performance. Utilize stranded cable within a round, flame retardant jacket, modular 8-position plugs on both ends, wired straight through, exceed FCC CFR 47 per 68 subpart F specifications, and have 50 micro-inches minimum of gold plating over nickel contacts, cable matching colored boot. Be available in standard lengths of 3, 5, 7, 10, and 15 feet.

B. Manufacturers: Siemens or equal.

2.4 PATCH PANELS

A. Copper Patch Panels (UDP): All termination panels shall facilitate cross- connection and inter-connection using modular patch cords and shall conform to EIA/TIA-568B standard, 19 inch relay rack mounting requirements, use of the same modular outlets used in the work area, 48 and 24-port configurations, individual machine labeled port identification numbers provided on both front and rear of the panel. Labeling scheme for each cable termination shall include room-outlet jack (e.g. 102-1-1, 102-1-2) designation. Provide 25% spare jack capacity.

B. Manufacturers: Siemens or equal.

2.5 CABLE

A. Horizontal Distribution: 4-pair, UTP, 24 AWG, solid copper conductors. UL verified to TIA/EIA 569B for category 6 performance and be plenum rated.

B. Manufacturers: General Cable, Corning or equal.

2.6 CONNECTORS

A. Horizontal Copper Connectors (modular jacks): 8-position/8-conductors, insulation displacement connection (IDC), non-keyed identified in accordance with TIA/EIA 568B.

B. Manufacturers: Siemens, Corning or equal.

2.7 PATHWAYS

A. Comply with TIA/EIA 569A.

B. Install no more than two 90-degree bends for a single horizontal cable run.

C. Conduit runs for single outlets shall be a minimum of 1-inch diameter or as shown on the Drawings.

D. Do not use flexible conduit for telecommunications cabling.

2.8 CABLE TRAY

A. See Section 26 05 33 for specifications.

2.9 LABELING AND ADMINISTRATION

A. Labels: As recommended in TIA/EIA 606. Permanently affixed and created by a hand carried label maker or software-based label making system. Handwritten labels are not acceptable.

B. Manufactures: Brady, Panduit.

2.10 RACK MOUNTED ELECTRONICS

A. Distribution Managed Ethernet Switches (Located in LCP NET and as shown on the Drawings)
   1. Power over Ethernet (PoE)
   2. Manufacturer: Allen Bradley STRATIX 5700

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wire and cable in accordance with manufacturer's instructions and in accordance with EIA/TIA-568B.

B. Install all cables in conduit, cable trays, or support rings.

C. Support raceways and racks under provisions of Section 26 05 33.

D. Install pull string in each empty conduit over 10 feet in length or containing a bend.

E. Terminate all telephone and data cables on terminal block and at outlet jacks.

F. Rack and support all cables in workmanlike manner. Identify each cable with room number and outlet served. Provide detailed, accurate record drawings of cable and termination layout.

G. Telephone and data layout and marking:
   1. Maximum height for terminal blocks shall be 6'-0".
   2. Telephone and data wiring shall terminate on separate blocks. Cables shall be marked with Raychem TMS sleeve-type markers at both ends. Adhesive wrap-on markers are not acceptable.
   3. Layout telephone and data terminal blocks with spacing as recommended by manufacturer.
   4. Jack numbering: Room number – Outlet number – Jack number.

H. Ground shall be installed in accordance with Section 26 05 26 and EIA/TIA-568.

3.2 TESTING

A. Provide test records on a form approved by the Owner. Include test results for each cable in the system. Submit the test results for each cable tested identified by labeled number. Include the cable identifier, outcome of the test, indication of errors found, cable length, retest results and the name and signature of the technician completing the tests. Provide test results to the Owner for review and acceptance a minimum of two weeks prior to Substantial Completion.

B. Test all cable on the reel upon delivery to the jobsite prior to installation and again after installation.

C. Use TIA/EIA Level III testing instrument, re-calibrated within the manufacturer's recommended calibration period, with the most current software revision based upon the most current TIA/EIA testing guidelines, cable of storing and printing test records for each cable within the system. Fluke DSP-4000 or approved equal.

D. Copper Cabling:
   1. Test each end-to-end link (entire length from outlet connector to rack termination) utilizing sweep tests, for continuity, shorts, polarity, near-end cross talk (NEXT),

far-end cross talk (FEXT), attenuation, installed length, transposition (wire map), mutual capacitance, characteristic impedance, resistance, ACR and presence of AC voltage. Use the Power Sum method to text NEXT and FEXT. All cable shall demonstrate compliance with TIA/EIA 568B Category 6.

E. Identify cables and equipment that do not pass to the Owner. Determine the source of the no-compliance and replace or correct the cable of connection materials and retest with no additional expense to the Owner and publish with final test results.

3.3 DOCUMENTATION AND ACCEPTANCE

A. Prepare a details as-built record document (drawing) detailing the layout of all telephone and data terminal jacks, outlets, and racks in accordance with EIA/TIA-606 complying method prior to acceptance. Database of termination information shall be submitted following acceptance to Owner.

END OF SECTION

SECTION 27 30 00 – PLANT SOUND SYSTEM

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide the plant intercommunication system and all accessories, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 26 00 00 - Electrical Work, General apply to the WORK of this Section.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

NEC	National Electrical Code; Article 800 Communication Circuits
EIA	Electronic Industries Association Standards
ANSI/IEEE 241	Electric Power Systems in Commercial Buildings, Recommended Practice for
ANSI/NEMA 250	Enclosures for Electrical Equipment

1.3 CONTRACTOR SUBMITTALS

A. Shop Drawings and catalog data submittals shall be made in accordance with MASS Section 10.05 Article 5.6.

B. The CONTRACTOR shall submit sufficient information to indicate the scope and quality of the intercommunication system installation.

1. Block diagram showing system relationships of major components and quantities and interconnecting cable requirements.
2. Plans showing equipment locations, raceway, and conductor requirements.
3. Control console and panel arrangements, equipment outlet devices, and special mounting details.
4. Wiring diagrams showing terminal identification for field-installed wiring.
5. Catalog literature.

C. The CONTRACTOR shall furnish 6 copies of the operating and service manuals for the system. The manuals shall be bound in flexible binders and all data contained therein shall be printed or typewritten. Each manual shall include all instruction necessary for proper operation and receiving of the system, and shall include a complete block diagram of the system, a complete circuit diagnosis of the system,

and a wiring designation schedule for each amplifier as well as other major components, and a replacement parts list.

1.4 QUALITY ASSURANCE

A. Plant intercommunication system components shall be manufactured by firms that are regularly engaged in the production of amplifiers, speakers, telephones, and auxiliary equipment similar to that required for this project and that have been in satisfactory service for at least 5 years.

B. The firm installing the plant intercom system shall have had prior successful installation experience with plant intercom systems similar in scope to the system of this project.

C. Operation of the plant intercom system shall be demonstrated to the ENGINEER to prove that under normal conditions coverage complies with this specification, there is no feedback, and that signal access to the system is as required.

1.5 MAINTENANCE DURING CORRECTION OF DEFECTS PERIOD

A. The CONTRACTOR shall include in the bid the cost of all labor, material, including pilot lamps, fuses, appliances, equipment, and adjustments required to maintain the system in normal operating condition for a period of one year following the completion date of the contract.

PART 2 - PRODUCTS

2.1 GENERAL

A. The system equipment shall be furnished by a factory distributor who shall have been engaged in providing systems of equal scope to that described for at least 5 years. Equipment or components showing inherent defects of a mechanical or electrical nature shall be replaced promptly at no cost to the OWNER.

B. Description of System: The Plant Sound System shall provide audio alarms from the audio output of the SCADA system PCs and the plant IP phone system. The system shall be composed of amplifier-mixers, speakers, and all necessary wiring conduit, junction boxes and accessories required to provide a complete operating system. Taps of line matching transformers shall be selected for uniform sound intensities when installed. Items of equipment required for a complete and operable system, even though not described herein or shown on the Drawings, shall be provided by the CONTRACTOR.

C. Equipment

1. Audio Amplifier shall provide the following features:

    a. (2) 1v audio inputs from PCs with gain/trim control and bass& treble controls

b. (2) Telephone inputs that provide loop start or ground start trunk interfacing
c. 4 – levels of priority between modules
d. Switches to permit user to select either transformer-coupled outputs or direct low impedance output.
e. Compressor/limiter signal processing output module that inserts into the mix bus signal path and power amplifier stage.
f. 125hz low cut feature g. Rack mounting
g. 35W continuous RMS power rating
h. Amplifier shall be Bogen, Model Power Vector V-35, or equal

2. Cables shall be provided to all speaker locations and handset stations as indicated and as required. CONTRACTOR shall provide all necessary cables to perform the functions as specified. Speaker cable shall be tinned copper, twisted pair, vinyl insulated, 16-gauge minimum; station cable shall be copper, twisted pair, within an overall jacket, in quantities to satisfy project requirements. Shielding or twisted pair shall be provided as required.

3. Weather Proof Speakers: Weather proof speakers (Interior and Exterior) shall be horn speakers rated for outdoor use. Speakers shall have low pass filter with 70V input and stepped attenuator volume control mounted on the speaker. Speakers shall be Bogen model HS15EZ or equal.

4. Telephone Interface: Telephone interface shall be compatible with standard analog port types including ATA and 1V 100K audio preamp outputs and provide standard 0-1V audio outputs. The unit shall provide the following
   a. emergency override and general paging
   b. level control for each output
   c. page level limiter
   d. adjustable automatic level control
   e. tone burst
   f. wall mounted design
   g. UL listed
   h. Bogen Single-zone Universal Telephone Interface or equal

5. Digital Feedback Terminator: Digital Feedback Terminator shall eliminate acoustic feedback loops and stack messages. The unit shall provide the following:

   a. record a message while another message is played
   b. stack up to 16 messages of 60 seconds
   c. wall mounted
   d. activate recording by loop start, 4 wire dry loop, or audio trigger
   e. connect to VOIP gateway
   f. Bogen Model DFT120 or equal

6. VOIP Gateway: Voice Over IP Gateway: Shall provide interface to send paging communications over Ethernet TCP/IP networks: The unit shall provide the following:
   a. Ethernet connectivity with full IP compatibility with CISCO internet hardware

b. Work with single or multi-zone paging when used the telephone interface and digital feedback terminator
c. Connect directly to phones or PBX
d. support FXS, FXO, and E&M port standards
e. remotely managed using windows software with web browser
f. Bogen Model MVP-XXXBG or equal

PART 3 - EXECUTION

3.1 GENERAL

A. All materials and equipment shall be installed in accordance with the printed recommendations of the manufacturer and the requirements of the Contract Documents. Equipment shall be installed plumb and square, shall be adequately ventilated, and shall be securely anchored.

B. If the raceway indicated does not conform to the CONTRACTOR-chosen routing of cable, it is the CONTRACTOR's responsibility to modify the raceway system as acceptable to the ENGINEER.

3.2 WORKMANSHIP

A. Conductor terminations at screw terminals shall be accomplished with hooked, spade lugs. Shielding shall be continuous and shall be grounded at the amplifier which shall be frame grounded. Wiring shall be cabled within enclosures and banded neatly to terminals.

3.3 INSTALLATION

A. Speakers shall be mounted to minimize the possibility of acoustic feedback between telephone stations and loudspeakers. Speakers, grilles, and back boxes all shall be mounted to eliminate acoustic resonance and vibration. Wiring throughout the system shall be identified in accordance with Shop Drawings; identification shall be applied at all terminations and access fittings.

3.4 EXECUTION OF TEST PROCEDURES

A. The CONTRACTOR shall operate all equipment, in the presence of the ENGINEER, to demonstrate signal input from malfunction panel, microphone, and telephone system. Prior to such test the CONTRACTOR shall have placed all speakers, adjusted speaker power output for proper paging coverage, and corrected all hum and feedback problems to the ENGINEER's satisfaction. At completion of test all adjustments shall be locked or sealed.

END OF SECTION

SECTION 28 31 00 – FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The features and capacities described in this specification are required as a minimum for this project. The new FDAS equipment and circuits shall replace the existing as shown on the drawings.

B. The system shall include all required hardware, raceways, interconnecting wiring and software to accomplish the requirements of this specification and contract drawings, whether or not specifically indicated.

C. All of the equipment furnished shall be new and the latest state-of-the-art products from a manufacturer with at least five years experience in the FDAS industry.

D. The system components shall be supplied, installed, tested and approved by the local Authority Having Jurisdiction (AHJ) and turned over to the Owner in operational condition.

E. In the interest of job coordination and responsibilities, the installing Contractor shall contract with a single supplier for the fire alarm equipment, engineering, programming, inspection and tests and shall be capable of providing a “UL Listing Certificate” and FM Approval for the complete system. The supplied equipment shall fully compatible with or of the same manufacturer as the existing system.

F. The Contractor shall make use of a System Integrator for work associated with the existing facility SCADA system. Listed fire alarm auxiliary modules shall be supplied by the Contractor to provide input to the SCADA system if required.

G. Provide devices and connections as required for use in hazardous locations indicated on the Drawings.

H. Contractor shall be responsible replacing the existing wiring such that new SLC’s are ‘Class A’. Where existing appliance locations are adjusted and existing wiring cannot accommodate connection, new wiring shall be installed; splices will not be allowed without written consent from the Engineer.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Condition, apply to this Section

B. Related Sections:
   1. Division 26 – Electrical

C. FM Global Data Sheet 5-40, Fire Alarm Systems

1.3 DEFINITIONS

A. Addressable: A fire alarm system component with a unique identification that can have its status individually identified or that is used to individually control other functions.

B. Fire Alarm Control Panel (FACP): A component of the fire alarm system, provided with primary and secondary power sources, which receives signals from initiating devices or other fire alarm control units, and processes these signals to determine part or all of the required fire alarm system output function(s).

C. FM: FM Global (Factory Mutual).

D. Furnish: To supply the stated equipment or materials. Install: To set in position and connect or adjust for use. LED: Light-emitting diode.

E. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

F. NICET: National Institute for Certification in Engineering Technologies. Provide: To furnish and install the stated equipment or materials.

G. UL: Underwriters Laboratories.

1.4 SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS

A. System shall be a complete, supervised, addressable, fire detection and notification system installed and connected in accordance with the specifications and as indicated on the Drawings.

B. Each Signaling Line Circuit (SLC) and Notification Appliance Circuit (NAC): Limited to only 80 percent of its total capacity during initial installation.

C. General Performance: Comply with NFPA 72 and all contract documents and specification requirements.

D. All interconnections between this system and the monitoring system shall be arranged so that the entire system can be UL-Certificated.

E. Basic Performance:
   1. Signaling Line Circuit (SLC) serving addressable devices: Class A, Style 7.
   2. Initiation Device Circuits (IDC) Serving Non-addressable devices connected to addressable monitor modules: Wired Class A (NFPA Style D).
   3. Notification Appliance Circuits (NAC) Serving Strobes and Horns: Wired Class A (NFPA Style Z).
   4. Strobes shall be synchronized throughout the entire facility.
   5. For Style 7 (Class A) Configurations: Single ground fault or open circuit on Signaling Line Circuit shall not cause system malfunction, loss of operating power, or ability to report alarm.

6. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage and placement of system modules within the FACP.
7. The FACP shall report trouble and alarm signals to AWWU's SCADA system.

F. The system shall provide an off-normal warning prior to reset for all active devices.

G. Fire alarm signal initiation shall be by one or more of the following devices:
1. Manual pull station
2. Heat detector
3. Addressable area smoke detectors,
4. duct smoke detectors
5. Combustible Gas %LEL (Lower Explosive Limit) Detector
6. As indicated on the drawings.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the Authority Having Jurisdiction (AHJ) has adopted an earlier version.
1. FM Global (Factory Mutual (FM)): FM Approval Guide
2. National Fire Protection Association (NFPA)

NFPA 13 – Installation of Sprinkler Systems

NFPA 70 - National Electrical Code

NFPA 72 - National Fire Alarm Code

NFPA 101 - Life Safety Code

3. Underwriters' Laboratories, Inc. (UL) equipment standards, Latest Edition

UL Fire Protection Equipment Directory

UL Electrical Construction Materials Directory

UL 38 – Manually Actuated Signaling Boxes for Use With Fire Protection Signaling Systems

UL 268 - Smoke Detectors for Fire Protective Signaling Systems

UL 464 - Audible Signal Appliances

UL 497A – Secondary Protectors for Communications Circuits

UL 521 - Heat Detectors for Fire Protective Signaling Systems

UL 864 - Control Units for Fire Protective Signaling Systems

UL 1283 – Electromagnetic Interference Filters

UL 1449 - Transient Voltage Surge Suppressors

4. International Code Council

International Building Code

International Fire Code.

5. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction, M.A.S.S., ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.

1.6 SUPPLIER QUALIFICATIONS

A. The manufacturer of the supplied products must utilize product distribution on a national basis to be considered for this bid. The manufacturer must have factory branches as well as independent distributors to allow the end user with the ability to utilize factory trained and authorized competitive service providers after system installation and commissioning.

B. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be licensed in the State if required by law.

C. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the Owner's personnel in the system operation and maintenance manual.

D. The suppliers shall furnish evidence they have an experienced service organization, which carries a stock of spare and repair parts for the system being furnished.

E. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the detection system and shall be able to produce a certificate stating such upon request.

1.7 INSTALLER QUALIFICATIONS:

A. Provide names of projects, locations and telephones numbers to contact for at least two installations where contractor or subcontractor has installed fire alarm detection system that are similar in size and scope as this Project.

B. System design, installation and testing shall be performed by licensed firm(s) with established reputation in fire alarm industry having 5 years’ experience in design, installation and testing of fire alarm detection systems.

C. System shop drawings for code enforcement authority approval shall be prepared by a technician with a minimum of NICET Level III (or as required by AHJ) for fire alarm systems.

D. Technician with a minimum of NICET Level III Certification for fire alarm systems shall supervise installation execution and final commissioning of the Project.

E. Technician with minimum of NICET Level II Certification for fire alarm systems shall be available onsite.

F. The contractor shall be qualified by UL for certifying fire alarm systems.

G. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.

1.8 REGULATORY REQUIREMENTS:

A. Submit shop drawings and system design calculations for approval to the Alaska State Fire Marshall's Office.

B. Submit shop drawings and system design calculations for approval to MOA Building Safety for review and approval.

C. Testing Agency Qualifications: Qualified for testing indicated.

D. Source Limitations for fire alarm equipment: Obtain fire alarm equipment from single source.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. All Fire alarm devices for this project shall be FM Approved

F. Pre-installation Conference: Conduct conference at Project site.

1.9 SUBMITTALS

A. Documentation Submittals:
   1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.
   2. Power Calculations. The existing battery capacity calculations shall be revised to reflect the new equipment. Battery size shall be a minimum of 125% of the calculated requirement. Provide the following supporting information:
      a. Supervisory power requirements for all equipment. Alarm power requirements for all equipment.
      b. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
      c. Voltage drop calculations for wiring runs demonstrating worst-case condition.
      d. NAC circuit design shall incorporate a 20% spare capacity for future expansion.

B. Submit manufacturer's requirements for testing signaling line circuits and device addresses prior to connecting to control panel. At a minimum, the following tests shall be required: device address, the usage (Alarm, Supervisory etc), environmental compensation, temperature ratings for thermal detectors and smoke detector sensitivities. This requirement shall need approval before any wiring is connected to the control panel.

1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
    a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    b. Wiring Diagrams: For power, signal, and control wiring.
    c. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
        1) Floor plans in a CAD compatible format at a scale of 1/8"=1'-0" showing all equipment and raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.
        2) Incomplete submittals shall be returned without review, unless with prior approval of the Engineer.
        3) Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
    d. Fire protection equipment interfaces

C. Qualification Data: For qualified Installer, Applicator, manufacturer, fabricator, professional engineer, testing agency, and factory- authorized service representative.

D. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.

E. Test Reports: Indicate satisfactory completion of required tests and inspections

F. System Warranty: Provide sample warranty and final system warranty, with successful test results and system has been accepted.

G. Informational Submittals:

1. Experience and qualifications of firm(s) proposed to design and install the system.
2. Certifications documenting installing and service technician's training. Certification shall indicate name and individual, training, dates, systems qualified and current status.
3. Copy of design documents, Shop Drawings and calculation submitted to MOA Building Safety.
4. Code enforcement authority approval stamp on shop drawings. Operations and Maintenance Data as specified.
5. Written documentation for logic modules as programmed for system operation with matrix showing interaction of input signals with output commands.

6. System program hard copy and CD-ROM showing system functions, controls and labeling of equipment and devices
7. Actual system configuration program file at time of final system acceptance.
8. Documentation of system voltage, current and resistance readings taken during installation and testing of system.
9. System record drawings and wiring details including one set of reproducible masters and drawings on CD-ROM in a DXF format suitable for use in ACAD drafting software.
10. NFPA 72, Record of Completion: Submit to Owner and code enforcement authorities.
11. NFPA 72, Inspection and Testing Form: Submit to Owner and code enforcement authorities.

1.10 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.

B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.11 PROJECT CONDITIONS

A. Installed products or materials shall be free from any damage including, but not limited to, physical insult, dirt and debris, moisture, and mold damage.

B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 SYSTEM WARRANTY

A. Warrant all components, parts and assemblies against defects in materials and workmanship for a period of 12 months from the date of project final completion. Warranty service shall be provided by a trained specialist of the equipment manufacturer.

B. System revision levels to be brought up to manufacturer's latest version number as the close of the warranty period.

C. Re-testing if system is reprogrammed.

1.13 EXTRA MATERIALS

A. Smoke Detector and Base – Two sets per type

B. Horn/Strobe – One complete set

C. Strobes – One complete set

D. Heat Detectors - Two complete set Manual Pull Stations - One complete sets

E. Keys (FACP, manual pull stations, smoke detectors, etc.) – Two complete sets of each type.

F. Addressable Modules - One complete set Surge Suppressors – One complete set

G. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment furnished for this project shall be new and unused. All components and systems shall be designed for uninterrupted duty. All equipment, materials, accessories, devices, and other facilities covered by this specification or noted on the contract drawings shall be the best suited for the intended use and shall be provided by a single manufacturer.

B. System installation and operations shall be verified by the manufacturer's representative and a verification certificate presented upon completion. The manufacturer's representative shall be responsible for an on-site demonstration of the operation of the system and initial staff training as required by the Owner.

2.2 MANUFACTURERS

A. Siemens

B. Johnson Controls

C. Simplex

D. Grinnel

E. Substitutions: Approved Equal

2.3 FIRE ALARM CONTROL PANEL (FACP)

A. The existing FACP is microprocessor based with addressable detection and other initiation device information to control system output functions.

B. Software Modifications: The system programming shall be modified as required to accommodate the additional equipment and circuits.

2.4 INTELLIGENT INITIATING DEVICES

A. General

1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections.

B. Photoelectric Smoke and Heat Detector

1. Photoelectric addressable type with plug-in, twist-lock base per UL 217 and UL 268.
2. Solid state circuitry, nonradioactive photo-optic sensing chamber, suitable for device releasing service.
3. Integral thermal sensing element, set for restorable fixed-temp 135 deg. F (57 deg. C) trip.
4. Concealed, field adjustable, sensitivity test switch.
5. LED; pulsed indication for power availability and steady indication for activated detector
6. Self-Compensating Circuitry:
    a. Voltage Range: 15 to 30V dc, 24V dc nominal. Temperature Range: 0 to 38 deg. C
    b. Operating Temperature Range: Minus 10 deg. C to 50 deg. C.
    c. Humidity Range: 0 to 95 percent relative humidity.
    d. Photoelectric sensors adjusted within 3 percent of UL 217 window obscuration sensitivity valve.

C. Heat Detectors

1. Combination rate-of-rise and fixed, nonplug-in temperature elements with 135 deg. F (58 deg. C) trip setting, unless otherwise noted.
2. Non-restorable fixed temperature elements and self-restoring rate- of-rise temperature elements.
3. LED indicator for activated rate-of-rise temperature element or activated fixed temperature element.

D. Manual Pull Stations

1. Constructed of red molded polycarbonate material (Lexan) and raised white letters stating “FIRE”.
2. Surface or semi flush-mounted with hinged front cover having keyed reset lock.
3. Lift door and recessed pull handle, latched in protruding position until reset by key.
4. Stations keyed alike with FACP.
5. Screw terminal for field connections.
6. Microprocessor-based communication circuit with dip switch selectable address and compatible with FACP.
7. Provide devices and connections as required for use in hazardous locations indicated on the Drawings.

2.5 ADDRESSABLE INTERFACE DEVICES

A. Addressable Interface Devices shall be provided to monitor contacts connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contacts. An address will be provided for each contact. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated as required.

B. Where needed, a Conventional Zone Module shall connect to the Signal Line Circuit, which will allow the use of conventional initiation devices. This module shall have the ability to support up to 15 conventional smoke detectors and an unlimited number of contact devices. Where required, there shall be an intrinsically safe detection solution for NEMA defined intrinsically safe installations compatible with the conventional zone module.

2.6 NOTIFICATION APPLIANCES

A. Horn
   1. Operate on 24VDC or field-selectable outputs.
   2. Have two selectable tone options of temporal 3 and non-temporal continuous pattern.
   3. Have at least 2 audibility options.

B. Strobes:
   1. Compliance: ADA and UL 1971. Maximum Pulse Duration: 0.2 second. Strobe Intensity: UL 1971.
   2. Flash Rate: UL 1971.
   3. Strobe Candela Rating: Determine by positioning selector switch on back of device rated for: 15/30/75/110cd.
   4. Shall incorporate a Xenon flashtube enclosed in a rugged polycarbonate (Lexan) lens.

C. Horn/Strobe
   1. Operate on 24 VDC.
   2. Have two selectable tone options of temporal 3 and non-temporal continuous pattern.
   3. Have at least 2 audibility options. Maximum Pulse Duration: 0.2 second. Strobe Intensity: UL 1971.
   4. Flash Rate: UL 1971.
   5. Strobe Candela Rating: Determine by positioning selector switch on back of device rated for: 15/30/75/110cd.
   6. Shall incorporate a Xenon flashtube enclosed in a rugged polycarbonate (Lexan) lens.
   7. Horn/Strobe and standalone Horn Appliances shall have a minimum of three (3) field selectable setting for dBA levels, and shall have a choice of continuous or temporal (Code 3) audible outputs.

D. Provide devices and connections as required for use in hazardous locations indicated on the Drawings.

E. Go / No-Go Light Station operate on 24VDC

1. Green – Go LED, Red – No-Go LED, 50mm minimum, >30,000 hour design life

   NEMA 4X

2.7 INFRARED COMBUSTIBLE GAS SENSON/TRANSMITTER

A. Gas sensor/transmitter shall be capable of detecting combustible gases including methane, petroleum vapors and propane from 0-100% LEL levels.

B. Gas Monitor

1. Shall monitor for combustible hydrocarbon concentrations and shall be loop powered from a 4-20 mA signal.
2. The monitor shall self-test and automatically signal fault and fouled optics by driving the current to below 2.5 mA.
3. The sensor shall be immune to poisoning by silicone and hydrides and impervious to etching by halogen compounds.
4. The analyzer shall be unimpaired by high concentrations or prolonged exposure to hydrocarbons as well as oxygen depleted atmospheres.
5. The sensor shall incorporate multi-layered filter system protects optics from dirt and water and shall be heated.
6. The sensor shall detect methane, ethane, propane, butane, ethylene, and propylene.
7. The accuracy shall be 3 percent from 0 to 50 percent LFL, and 5 percent from 51 percent to 100 percent.
8. Stability shall be 12 months at 2 percent LFL.
9. Temperature shall be –40 degrees C to +75 degrees C at 0 percent to 99 percent relative humidity.
10. The response time shall be less than 10 seconds.
11. The unit shall be made from copper-free aluminum and stainless steel and shall be rated NEMA-4X.
12. The unit shall include a tall cover/Window junction box for one person, non-intrusive calibration.
13. Service Range 0-100% LEL
14. NEMA Rating Indoor 4X
15. The Unit shall be certified by CENELEC, FM and UL.
16. The analyzers shall be **Detector Electronics Corporation Model PIR9400 or equal.**
17. Provide analyzers as shown on the Contract Drawings

C. Sensor/transmitter enclosure shall be 316 stainless steel explosion-proof.

D. The infrared (IR) combustible sensor must be capable of calibration without gas. The sensor/transmitter must be capable of performing a full calibration by zero adjustment only.

E. The IR sensor/transmitter shall detect for an above 100% LEL condition (over-range). This condition must be indicated on the front panel LCD.

F. The IR sensor/transmitter shall not contain a flashback arrestor / frit.

G. The IR sensor/transmitter must allow for a gas check without alternate calibration / gas check fittings or cap.

H. Operating Voltage – The sensor/transmitter shall operate between 8- 30VDC loop power.

I. Sensor/Transmitter electronics shall consist of one PCB. This PCB shall offer expandability to allow for optional LED's and relays.

J. The single PCB shall not require tools for installation or removal. The single PCB must be self-aligning in the enclosure.

K. Sensor/transmitter shall allow for optional reset connector for resetting latched alarms.

L. Set-up and start-up of the sensor/transmitter will be so that the enclosure need not be opened during this process.

M. Sensor/transmitter shall be factory calibrated, ready for use out of the box. A gas check is all that is required to ensure proper operation.

N. Sensor/transmitter shall contain no pots, jumpers or switches.

O. Sensor/transmitter output shall be 4-20mA.

P. Sensor/transmitter shall have optional relays provided. Relays shall be rated at 5 amps @ 30VDC, 5 amps @220VAC, single-pole, double-throw and consist of three for alarm levels and one for fault. All relay contact activation with be monitored. If the relay cannot activate for any reason, the trouble relay will change state. All relays shall be field selectable through a non-intrusive hand-held wireless remote control unit or a HART hand held communicator. Selectable features include:
    1. Alarm level
    2. Latching / Non-latching
    3. Upscale / Downscale
    4. Normally-opened / Normally-closed
    5. Energized / De-energized over selected periods of time.

Q. Sensor/Transmitter shall allow for full range scaling of the 4-20mA output signal.

R. The sensor/transmitter shall be capable of storing and displaying average. Minimum and maximum gas concentrations over selected periods of time.

S. The sensor/transmitter will give an indication of when sensor is nearing the end of its useful life by means of the front panel LCD. This indication that the sensor is nearing its useful life will be based on the sensor output. It shall not be based on the time the sensor was in service.

T. The sensor/transmitter units can be located remote from a monitor/readout unit by up to 4000 feet via proper gauge wire.

U. Sensor/Transmitter Remote Sensor Mounting:

1. The sensor portion of the sensor/transmitter unit will be capable of being able to be remotely mounted from the electronics and display. The separate sensor enclosure will be able to be mounted up to one hundred (100) feet from the main enclosure.
2. The sensor housing for the explosion-proof Gas Monitor will be in an enclosure suitable for location in Class I, Division 1, Groups A, B, C & D, Class II, Division 1, Groups E & F, Class III classified areas.
3. A two twisted pair cable will connect the sensor housing and the calibration electronics.
4. The readout portion of the sensor/transmitter shall have a display of the concentration of gas present. The display will be visible from a minimum of 5 feet and will be present at all times. It will not be required to be turned on or off. This readout will be three, one half inch digit Liquid Crystal Displays (LCD).

2.8 SENSOR/TRANSMITTER DISPLAY

A. There will be a local display indicating the gas type being monitored and the concentration of gas present. The display will alternate between the gas type (1 second) and gas concentration (5 seconds). The display will be an integral part of the sensor/transmitter enclosure. The display will be visible from a minimum of 5 feet and will be present always, and will not require being turned on or off. This readout will be three, one half-inch (3 1/2") digit Liquid Crystal Displays (LCD).

B. Sensor/transmitter display shall indicate all diagnostic check/fault conditions with a scrolling message detailing the condition. Error codes shall not be used.

C. Sensor/transmitter shall display 3 levels of alarm. Alarm levels will be adjustable by means of a hand help infrared controller or a HART hand held communicator.

D. Sensor/transmitter shall have LED’s, viewable from 50 feet. LED’s shall operate as follows:

Solid green LED – normal operation

Solid red LED – fault condition

Blinking red LED – alarm condition

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Perform work in accordance with the requirements of NFPA 70, NFPA 72 and NECA 1-2006, Standard of Good Workmanship in Electrical Contracting.

B. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces. Structural supports shall be stainless steel in process areas; galvanized steel in non-process areas.

C. Do not install smoke detectors before system programming and test period. If construction is ongoing during this period, take measures to protect smoke detectors from contamination and physical damage.

D. In the event that limited energy cable installation is allowed, all cable runs shall be run at right angles to building walls, supported from structure at intervals not exceeding 3 feet.

E. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces. All raceways and wiring shall be concealed in the administration area.

F. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

H. Ensure manual stations are suitable for surface mounting or semi-flush mounting as indicated on the Drawings. Install not less than 42 inches, nor more than 48 inches, above finished floor measured to operating handle.

I. Provide primary power for each panel from normal/ emergency panels as indicated on the Electrical Power Plans. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices.

J. Field inspection and testing shall be performed under provisions of Division 26.

K. Test 100% of devices in accordance with NFPA 72 and local fire department requirements.

L. Provide test report to Owner.

3.3 BOXES, ENCLOSURES AND WIRING DEVICES

A. Boxes shall be installed plumb and firmly in position.

B. Extension rings with blank covers shall be installed on junction boxes where required.

C. Junction boxes served by concealed conduit shall be flush or semi-flush mounted.

D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.

E. here existing devices are removed and not replaced, suitable covers shall be installed or the location shall be repaired and refinished to match the existing undisturbed surface.

3.4 CONDUCTORS

A. Each conductor shall be identified with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.

B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.

C. Wiring for strobe and audible circuits shall be a minimum #14 AWG (#12 AWG if required for voltage drop), signal line circuits minimum #18 AWG twisted.

D. All splices shall be made using solder-less connectors. All connectors shall be installed in conformance with the manufacturer recommendations.

E. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.

F. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.

G. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

3.5 DEVICES

A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.

B. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

C. All devices and appliances shall be mounted to or in an approved electrical box.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26.

B. Junction, terminal and pulling box covers shall be painted red and identified with engraved labels by loop number and circuit that it contains.

C. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.

D. A consistent color code for fire alarm system conductors shall be submitted and used throughout the installation.

E. Detection and terminal devices shall have printed alphanumeric identification that shall be identified in the operations and maintenance instructions.

3.7 ACCEPTANCE TESTING

A. A written Acceptance Test Procedure (ATP) for testing the fire alarm system components and installation shall be prepared by the Contractor in accordance with NFPA 72 and this specification. The Contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits and programming.

B. The installing Contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.

C. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Owner and test results recorded for use at the final acceptance test.

D. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.

E. Final Acceptance Test: Notify the Owner in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. A final acceptance test will not be scheduled until megger test results, the loop resistance test results, and the submittals required in Part 1 are provided to the Owner. Test the system in accordance with the procedures outlined in NFPA 72.

   1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.

2. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
4. Visually inspect all wiring.
5. Verify that all software control and data files have been entered or programmed into the FACP.
6. Verify that Shop Drawings reflecting as-built conditions are accurate.
7. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.
8. Measure voltage readings for circuits to assure that voltage drop is not excessive.
9. Measure the voltage drop at the most remote appliance on each notification appliance circuit.

F. The Owner shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the Owner shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:

1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of
   a. Open, shorted and grounded signal line circuits.
   b. Open, shorted and grounded notification, releasing circuits.
   c. Primary power or battery disconnected.
2. System notification appliances shall be demonstrated as follows:
   a. All alarm notification appliances actuate as programmed
   b. Audibility and visibility at required levels.
3. System indications shall be demonstrated as follows:
   a. Correct message display for each alarm input at the control display.
   b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.
   c. Correct history logging for all system activity.
4. System off-site reporting functions shall be demonstrated as follows:
   a. Correct zone transmitted for each alarm input Trouble signals received for disconnect
   b. Demonstrate proper function of auxiliary signals to the SCADA system
5. Secondary power capabilities shall be demonstrated as follows:
   a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
   b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully

charged battery bank.

c. System battery voltages and charging currents shall be checked at the FACP.

3.8 DOCUMENTATION

A. System documentation shall be furnished to the Owner and shall include but not be limited to the following:

1. System record drawings and wiring details including one set of reproducible drawings, and a CD ROM with copies of the record drawings in DXF format for use in a CAD drafting program.
2. System operation, installation and maintenance manuals.
3. System matrix showing interaction of all input signals with output commands.
4. Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.
5. System program showing system functions, controls and labeling of equipment and devices.

3.9 DEMONSTRATION

A. Training sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the Owner.

B. Required Instruction Time: Provide 2 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as selected by the Owner. The instruction may be divided into two or more periods at the discretion of the Owner. One training session shall be videotaped by the Contractor. Videotapes shall be delivered to the Owner.

1. Comprehensive system troubleshooting training shall be provided for a single individual designed by the Owner. This session shall be separate and distinct from the above described sessions.
2. All training sessions shall be conducted following final system certification and acceptance. An additional training session shall be provided for all Owner's personnel six months after final system certification.
3. All training sessions shall be conducted by an authorized fire alarm system distributor representative, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided.

3.10 ACCEPTANCE

A. Contractor shall have on hand at the site ready for turn over to Owner at the time of the acceptance:

1. Accurate record drawings (final shop drawings are acceptable).
2. Operations and Maintenance (O&M) manuals are complete and accurate.

B. Equipment Revision Levels shall meet the manufacturer's most current version (hard-firm/software) at the time of system delivery (acceptance) for the major head-end modules; and no greater than one year/one version level old for field devices and minor modules.

C. Contractor's 100% functional testing, final test reports and device adjustments have been completed and full system operation confirmed prior to calling for Acceptance.

END OF SECTION

SECTION 33 01 30 – SANITARY SEWER FLOW CONTROL

PART 1 - GENERAL

1.1 SUMMARY

1. The CONTRACTOR is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting wastewater flows around Pump Station 2 as necessary to complete the Work.

2. The design, installation, and operation of the temporary bypass pumping system shall be the CONTRACTOR's responsibility.

3. Sewer flow control is to be completed such that it will not damage public or private property. Repair and reparations for property damage associated with Work is the sole responsibility of the CONTRACTOR to fix, clean and make whole.

4. Schedule and perform Work in a manner that does not cause or contribute to incidence of overflows, releases or spills of wastewater from bypass operations. The CONTRACTOR shall be responsible for any and all violation notices, fines and remediation measures as a result of wastewater spillage or discharge associated with bypass pumping activities.

5. The CONTRACTOR shall provide all trained and experienced labor and supervision for operating, maintaining, and trouble-shooting the pumping system during the entire bypass pumping operation.

6. The duration of bypass pumping operations depends on the CONTRACTOR's time required to perform the Work. Actual bypass times may vary depending on the CONTRACTOR's work plan. The CONTRACTOR will not be granted additional compensation for bypasses which extend beyond the approved work plan schedule.

7. Any traffic maintenance, to include rerouting of the Coastal Trail, required to perform bypass pumping operations shall be the responsibility of the CONTRACTOR.

8. The CONTRACTOR shall be responsible for the security of the bypass pumps and piping to include general public safety and protection during all Work.

9. Removal and resetting of manhole frames and covers, top riser sections, and/or top slabs required to construct the temporary bypass pumping system shall be included in the bid. All repairs after the Work is complete shall be in accordance with the most current edition of MASS.

1.2 SUBMITTALS

1. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

2. Submit a detailed Bypass Pumping Plan for review and approval by the ENGINEER. The plan shall include, at a minimum, the following:

3. Narrative describing the normal bypass operations.

4. Contact information of the Sewer Flow Control Supervisor who is responsible for operating and maintaining the bypass system.

5. Key personnel being used for 24-hour operations.

6. Copy of noise permit application and approved permit once it is received.

7. Layout showing proposed location, bypass pump and piping configuration, quantity of pumps, fuel storage areas, spill protection, security fencing, and barriers.

8. Bypass pump sizes, number of each to be on site and power requirements.

9. Number, size, material, location and method of installation of suction piping.

10. Number, size, material, location and method of installation of discharge piping.

11. Details on pump controls and instruments to safely operate and alarm the system.

12. Calculations of static lift, friction losses, and flow velocity. Pump curves showing pump operating range.

13. Size and material of suction and discharge piping.

14. Thrust restraint sizes and locations.

15. Any temporary pipe supports and anchoring required.

16. Sewer plugging method and type of plugs.

17. Construction sequence and schedule for installation and maintenance of bypass pumping lines.

18. Procedures to monitor upstream mains for backup impacts.

19. Emergency response plan detailing procedures to be followed in the event of pump failures, sewer overflows, service backups, and sewage spillage.

20. Method of noise control for each pump and/or generator.

1.3 QUALITY ASSURANCE

1. Perform leakage and pressure tests on discharge piping using clean water, before operation. Notify ENGINEER 24 hours prior to testing.

2. Maintain and inspect temporary bypass pumping system 24 hours per day (continuously) for the duration of bypass pumping operations. The CONTRACTOR must be ready to react within 15 minutes of any alarm or malfunction.

3. Keep and maintain spare parts for pumps and piping on site, as necessary.

4. Maintain adequate hoisting equipment and accessories on site for each pump.

5. The bypass pumping and piping specialty vendor shall have been in business for a minimum of 15 years. They shall have a major service center within 50 miles of the project site.

6. Bypass pumping system shall be designed and sealed by a Professional Engineer licensed in the State of Alaska.

7. The CONTRACTOR shall protect water resources, wetlands, and other natural resources.

1.4 DELIVERY, STORAGE, AND HANDLING

1. Transport, deliver, handle, and store pipe, fittings, pumps, ancillary equipment and materials to prevent damage and in accordance with the manufacturer's recommendations.

2. Inspect all material and equipment for proper operation before initiating work.

1.5 SYSTEM DESCRIPTION

1. The bypass pumping system shall have sufficient capacity to pump peak flows of 16 MGD at 95 feet TDH. Nighttime flows decrease to as low as 4 MGD.

2. The bypass pumping system shall include four pumps (minimum), power generation (if electric pumps), dual 24-inch HDPE suction headers, dual plugs, fuel storage, controls, discharge and suction piping, security fencing/barricades, temporary relocation of Coastal Trail, compressors, valves, gauges, and thrust restraint.

3. The bypass pumping system shall include two duty pumps and one standby pump installed. All three pumps shall be connected to the system and ready for use. A fourth pump shall be on-site and available for installation upon failure of one of the three installed pumps.

4. The bypass operation shall include all necessary controls and instruments to operate the system in automatic mode to include adjusting the pump speed, number of pumps, and providing alarms.

5. A temporary pressure transducer shall be installed within the influent manhole and shall be used to control the discharge rates of the pumps as necessary to maintain a wastewater level not higher than -8 feet. A high-level alarm float shall also be installed.

6. The CONTRACTOR shall provide an onsite diesel fuel storage tank(s) and containment for the pumps. CONTRACTOR is responsible for providing fuel throughout the bypass pumping operations. The onsite fuel storage tank(s) shall be sized to store enough fuel for running the entire system for a minimum of 3 days continuously under full load.

7. If electric pumps are utilized, a redundant power source shall be available on-site.

8. The system layout shall provide for ready removal and replacement of every pumping unit without affecting the others.

9. The temporary bypass system shall be equipped with pressure gauges on the discharge piping for each pump.

10. Isolation valves shall be installed on the suction and discharge piping for each pump. A check valve shall be installed on the discharge piping between the pump and isolation valve.

11. It is essential to the operation of the existing sewer system that there will be no interruption in the flow of wastewater throughout the duration of the project.

PART 2 - PRODUCTS

2.1 TEMPORARY BYPASS PIPING

1. Provide watertight hoses, piping, and fittings of sufficient capacity and pressure rating to accomplish the sewer bypass.

2. CONTRACTOR is to have replacement conduit and fittings on-site to make multiple repairs to the conduit.

3. Where hoses are provided, the CONTRACTOR is to have on hand two sections of replacement hoses that are capable of covering the longest single hose in the flow control system.

4. May be of new or used materials and shall not leak during operation.

5. Abrasion resistant.

6. Suitable for intended service.

7. Rated for anticipated external and internal loads, including test pressure.

2.2 PLUGS

1. Selected and installed according to size of line to be plugged, pipe and manhole configurations, and based on specific site.

2. Plugs shall inspected before use for defects which may lead to failure.

3. Any plugs required for bypass pumping shall be of the compressed air type and shall be capable of and suitably anchored as necessary to withstand hydraulic pressures.

4. Plugs shall be secured with a tag line. The tag line is to extend and be secured to a point outside of the manhole or wet well in which it is being used. Airlines are not considered as tag lines.

5. Plugs shall have zero leakage.

6. Plugs shall include sufficient supply hose to extend above grade and connect to an air compressor to allow for continuous monitoring and pressurization of the plug.

2.3 PUMPS

1. Pumps shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in priming system.

2. May be electric or diesel powered.

3. Pumps with engines or associated combustion power units must be in compliance with the MOA noise ordinance. The CONTRACTOR is to apply for and receive a noise permit when required by the MOA noise ordinance.

4. Pumps shall be operated with variable frequency drives (VFD) and shall be controlled based on the wastewater elevation in the influent manhole.

5. Constructed to allow for dry running for long periods of time to accommodate cyclical nature of effluent flows.

6. Pumps shall be capable of handling raw, unscreened, sanitary sewage containing solids and fibrous materials. Pumps shall be non-clog and shall be capable of passing 3.5-inch solids.

PART 3 - EXECUTION

3.1 INSTALLATION

1. Notifications is to be given to the sewer utility a minimum of seventy-two (72) hours to a maximum of one hundred forty-four (144) hours prior to commencement of the flow control.

2. The CONTRACTOR is responsible for locating any existing utilities.

3. When working inside a manhole, the CONTRACTOR shall exercise caution and comply with OSHA requirements for working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.

4. Install bypass pumping system plugs as follows:

5. One plug shall be installed in the influent manhole.

6. One plug shall be installed within the diversion box.

7. One additional spare plug shall be on-site and available for installation.

8. The CONTRACTOR is to monitor upstream components of the sewer collection system.

9. Upon completion of bypass pumping, the CONTRACTOR shall:

10. Remove all equipment and materials and restore all surfaces to preconstruction condition.

11. Install blind flanges on the 24-inch suction headers.

12. Restore influent and discharge manholes.

END OF SECTION

SECTION 35 22 26 – FABRICATED STAINLESS STEEL SLUICE GATES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish and install stainless steel sluice gates and operators as shown on the Drawings and as described herein.

B. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer.

C. Gates and operators shall be supplied with all the necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of AWWA-C561-14 standards.

1.3 CONTRACTOR SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

B. The manufacturer shall submit for approval, drawings showing the principal dimensions, general construction and materials used in the gate and lift mechanism.

C. The manufacturer shall submit for approval, engineering design calculations showing that lift and stem as well as slide deflection calculations at a minimum are in compliance with AWWA standards latest edition.

D. The manufacturer shall provide to the Contractor for submittal to the Owner and Engineer the Manufacturer’s Certificate of Proper Installation and Operation of the equipment and systems of this section.

E. Test Reports: Indicate results of leakage tests.

1.4 PERFORMANCE

A. Sluice gates shall be substantially watertight under the design head conditions. Under the design seating head, the leakage shall not exceed 0.05 US gallons per minute per

foot of seating perimeter. Under the design unseating head, leakage shall not exceed 0.10 US gallons per minute per foot of perimeter.

1.5 QUALITY ASSURANCE

A. The manufacturer shall have 5 years experience in the production of substantially similar equipment and shall show evidence of satisfactory operation in at least 10 installations. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of AWS Sections D1.1, 1.2 and 1.6.

B. The fully assembled gates shall be shop inspected, tested for operation and fully adjusted before shipping. There shall be no assembling or adjusting on the job sites other than for the operating appurtenances.

1.6 MANUFACTURER'S SERVICES

A. Manufacturer's Representative shall be present at the job site for a duration as necessary for installation assistance, inspection, verification of installation, functional and performance testing.

B. The Manufacturer's Representative shall be a direct employee of the Manufacturer or certified by the Manufacturer. The Manufacturer's Representative shall have a minimum of 5 years of field services experience with the equipment furnished under this contract.

1.7 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements shall be in accordance with MASS 2015.

PART 2 - PRODUCTS

2.1 GENERAL

A. Design Requirements:
   1. Maximum Seating Head = 43 feet
   2. Max Operating Head = 43 feet
   3. Max Unseating Head = 5 feet

B. Gates shall be non self-contained of the non-rising stem configuration.

C. All parts of the gate shall have a minimum thickness of ¼ inch.

D. Materials:

Part	***Material***
Slide, Spigot, Frame, Stiffeners,	Stainless Steel Type 304L or 316L ASTM A276 / A240

Yoke, Guide Angles	
Side and Top Seals	Neoprene ASTM D-2000 G2BC 615
Invert Seal	Neoprene ASTM D-2000 G2BC 515
Bearing bars, Guides, Stem Guide Bushings	Ultra High Molecular Weight Polyethylene ASTM D4020
Threaded stem, Stem Guides	Stainless steel Type 304L or 316L ASTM A-276
Fasteners	Stainless steel Type 304 or 316 ASTM - F593 / F594
Pedestal	Steel ASTM A-36 or Stainless Steel 304L or 316L ASTM A312/276
Stem cover	Butyrate ASTM D-2411
Lift and stop nut	Bronze ASTM B584 / B505

E. Gates supplied under this section shall be Model GH-46 Wall Mount Stainless Steel Gates as manufactured by Golden Harvest Inc. (800-338-6238) or Engineer approved equal.

2.2 FRAME

A. The gate frame shall be stainless steel and designed for maximum rigidity.

B. The frame configuration shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the wall.

C. Frame shall be surface mount.

D. Anchor bolts shall be as specified by the Manufacturer.

2.3 SLIDE

A. The slide shall consist of stainless steel plate reinforced to limit deflection to L/360 of the span or 1/16-in, whichever is less, under the design head condition.

B. Slide shall be a double skin “sandwich” plate head design.

2.4 GUIDES AND SEALS

A. The guides shall be provided with ultra high molecular weight polyethylene seats on both sides of the slide and shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position. Guide frame shall not weigh less than 13 lbs. per foot.

B. Side and top seals shall be frame mounted. Seals shall be of a resilient neoprene P-seal with a stainless steel retainer bar. All seals shall be mechanical and fully adjustable. UHMW compression cord or UHMW contact seals will not be considered.

C. The flush bottom resilient neoprene seal shall be mounted to bottom of disc and seal against the invert portion of the frame. Frame mounted invert seals will not be considered.

2.5 STEM AND COUPLINGS

A. The operating stem shall be of stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lb effort on the crank or handwheel.

B. The stem shall have a slenderness ratio (L/R) less than 200. The threaded portion of the stem shall have ACME type cold rolled threads with a maximum surface of 16 micro-inches. Machine cut threads will not be considered.

C. Where a hydraulic, pneumatic or electric operator is used, the stem design force shall not be less than 1.25 times the output thrust of the hydraulic or pneumatic cylinder with a pressure equal to the maximum working pressure of the supply, or 1.25 times the output thrust of the electric motor in the stalled condition.

D. Stems in more than one piece shall be joined together by solid couplings.

2.6 STEM GUIDES

A. Stem guides shall be fabricated from stainless steel. Stem guides shall be equipped with a UHMWPE bushing. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendation. The L/R ratio shall not be greater than 200.

2.7 LIFTING MECHANISM

A. Existing actuators shall be connected to the new sluice gates. Adjust location of existing actuators as necessary to align with new sluice gate stem location. Contractor to verify compatibility. If existing actuators are not compatible, Contractor to notify Engineer.

B. Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 lb on the crank or handwheel, and shall be able to withstand, without damage, an effort of 80 lb.

C. Gearboxes shall be provided when required to maintain the operating force below 40 lb. All bearings and gears shall be totally enclosed in a weather tight housing. Operator housing shall be cast steel or cast iron. The pinion shaft of crank-operated mechanisms shall be supported by roller bearings. The operating shaft shall be fitted with a 2-inch square operating nut and removable crank. The crank shall be cast aluminum and fitted with a corrosion-resistant rotating handle. The maximum crank radius shall be 15 inches and the maximum handwheel diameter shall be 24 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with the manufacturer's recommendations.

B. Frame or frame components, pedestal, wall bracket, stem guide, and operator must be installed flat, straight and plumb. Shim and brace as necessary.

C. Tolerances:
   1. Parallel = ±1/8”
   2. Coplanar = ±1/8”
   3. Flat and straight = ±1/16”
   4. Square = ±1/8”

D. Stems for existing sluice gates are offset 9 inches from the face of wall. Adjust location of existing operators as necessary to align with new sluice gate stem location. Reconnect existing actuators to new sluice gates.

3.2 FIELD TESTING

A. Each sluice gate shall be tested for leakage.

B. Deficient gates shall be corrected at the Contractor’s expense.

END OF SECTION

SECTION 40 71 05 – FLOW DEVICES

1.1 WORK INCLUDED

A. The CONTRACTOR shall furnish and install flow sensors, complete and functional, as shown on the Drawings and as described herein.

1.2 RELATED SECTIONS

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

B. Division 26 – Electrical

C. 40 05 01 – Process Piping

D. 40 05 07 – Hangers and Supports for Process Piping and Equipment

E. 40 90 00 – Process Control and Instrumentation Systems

1.3 SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6.

B. Complete list of all deviations from the Drawings and Specifications.

C. Furnish submittals in accordance with the instrument requirements of specification Section 40 90 00, PROCESS CONTROL AND INSTRUMENTATION SYSTEMS.

D. Quality Control. Provide the following:
   1. Functional test and results of performance confirmation checks per specification Section 01 75 00, STARTING AND ADJUSTING.
   2. Operation and Maintenance Manuals: Include:
      a. Manufacturers recommended spare parts and special tools.
      b. Maintenance schedule showing the required maintenance, frequency of maintenance, and other items required at each regular preventative maintenance period.
      c. Manufacturer’s Certificate of Proper Installation and Operation.
      d. The Manufacturer shall provide written certification to Contractor for submittal to the Owner and Engineer that the equipment has been correctly installed and is operating properly.
      e. The Manufacturer shall submit to Contractor for submittal to the Owner and Engineer, results of testing performed and required by this specification.

f. Manufacturer's Certificate of Training: The Manufacturer will provide a list of signatures of operators who have completed the training requirements of this section.

1.4 MANUFACTURERS' SERVICES

A. A manufacturer's representative for items specified herein shall be present at the job for one(1) trips of two (2) days duration (not including travel time), for installation assistance, verification of installation, inspection, functional and performance testing, start-up and job-site training.

PART 2 - PRODUCTS

2.1 GENERAL

A. Instrument Brackets and Mounting Hardware: All instrument brackets and mounting hardware shall be stainless steel.

B. Third Party Listings: ALL equipment, systems, assemblies, controls and instrumentation, and appurtenant electrical components MUST be third party listed and labeled per the regulations of the State of Alaska. Third party listings include Underwriters Laboratories, Factory Mutual, and others suitable to the State of Alaska. Use listed materials in the Work according to the criteria for these listing

C. Code Conformance: All assembled components are to be configured and installed in accordance with applicable electrical codes observed in the United States and Alaska at the time the equipment is fabricated. Codes that apply include the National Electric Code, the National Electrical Contractors Association Standards, and other codes may apply as appropriate to the Work.

2.2 FLOW ELEMENT, INDICATOR/TRANSMITTER; DOPPLER FLOW METER

A. Flow Transmitter
   1. Operating Parameters:
      a. Liquids containing suspended solids or
      b. bubbles minimum size of 100 microns,
      c. minimum concentration 75 ppm.
   2. Programming: Built-in 5-button keypad with English, French, or Spanish language selection.
   3. Power Input: 9-32VDC 10W maximum
   4. Electronics Enclosure: NEMA4X (IP66) polyester with a clear polycarbonate face
   5. Accuracy : ±2% of reading or 30 mm/s (1.2 in/s) whichever is greater. Requires solids or bubbles minimum size of 100 microns, minimum concentration 75 ppm. Repeatability: ±0.1%, Linearity ±0.5%

6. Display: White, backlit matrix — displays flow rate, relay states, 16-digit totalizer, operating mode, and calibration menu
7. Analog Output: Isolated 4-20mA (1 kΩ load max.) or 0-5 VC (field selectable) HART Protocol
8. Control Relays: Qty 2, rated 5 A SPDT, programmable flow alarm, and/or proportional pulse
9. Data Logger: Built-in 26 million point logger with USB output and Windows software
10. Operating Temp. (Electronics): -23 °C to 60 °C (-10 °F to 140 °F)
11. Approximate Shipping Weight : 6.3kg (14 lb)

B. FLOW ELEMENT
1. Transducer: SE4 single-head stainless steel ultrasonic with 7.6 m (25 ft) shielded cable and designed to withstand accidental submersion to 10 psi.
2. Pipe Diameter: Any pipe ID from 12.7 mm to 4.5 m (0.5 in to 15 ft)
3. Flow Rate Range: ±0.46 m/s to 12.2 m/s (±0.125 ft/s to 40 ft/s) in most applications
4. Pipe Materials: Steel, stainless steel, cast iron, ductile iron, concrete-lined ductile iron, PVC, HDPE, or any contiguous pipe material that conducts sound, including lined pipes with a liner bonded to the pipe wall. Avoid pipes with loose insertion liners and pipe walls that contain air.
5. Operating Temperature: -40 °C to 150 °C (-40 °F to 300 °F)
6. Transducer Mounting Kit: Adjustable stainless steel mounting kit for pipes 12.7 mm (0.5 in) ID or larger.

C. Cable : 75Ft continuous shielded coaxial pair

D. Parts: Flow element, remote indicator transmitter, interconnecting cables, mounting hardware and calibration equipment.

E. Manufacturer: PULSAR Greyline DFM 6.1

PART 3 - EXECUTION

3.1 GENERAL

A. Flow sensors shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested per specification Section 40 90 00, PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

3.2 INSTALLATION

A. Install the flow meter in accordance with the Manufacturer’s written instructions.

SECTION END

SECTION 40 73 00 – PRESSURE MEASURING SYSTEMS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall provide pressure measuring systems, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 90 00 – Process Control and Instrumentation Systems apply to the WORK of this Section.

C. All instruments shall be FM-approved, or equal.

1.2 SUBMITTALS

A. General: Shop Drawings, Owner's Manual, and Record Drawings shall be submitted in conformance with the requirements of Section 40 90 00 – Process Control and Instrumentation Systems, and MASS Section 10.05 Article 5.6.

PART 2 - PRODUCTS

2.1 GENERAL

A. Electrical interface and code compliance shall conform to the requirements of Section 40 90 00 – Process Control and Instrumentation Systems.

2.2 ELECTRONIC PRESSURE TRANSMITTERS

A. Components: Electronic gauge and differential pressure transmitters shall consist of a capsule assembly, process connector and connection, amplifier unit, block and bleed valves, and conduit connection. Process connection shall be 1/2” NPT. Each transmitter installation shall include a manifold system and gauge as shown on the drawings. Process sensing lines shall be 1/4-inch stainless steel tubing.

B. Operating Principles: Pressure applied to the unit shall be transmitted to a sensing diaphragm made of stainless steel. Performance Requirements are:
   1. The amplifier unit shall convert the change in capacitance to a 4-20 mA DC signal, 2-wire type, with an allowable loop load of no less than 600 ohms.
   2. Static pressure rating shall be a minimum of 400 psig.
   3. The maximum over range pressure limit shall be a minimum of 150 percent of the minimum range.
   4. Device shall be submersible.
   5. All equipment shall be suitable for an ambient operating range of minus 40 degree F to plus 100 degrees F.
   6. Power supply shall be 24 VDC, loop powered.

7. Accuracy, including linearity and repeatability, shall be a plus or minus 0.2 percent of span.

C. Materials: All wetted parts shall be constructed of 316 stainless steel. Exposed parts shall be stainless steel or aluminum with polyurethane coating.

D. Pressure Range: 0-200 PSI

E. Submersible cable: 75FT

F. Manufacturer's Gauge Pressure Transmitters: **ASHCROFT A2**, or equal.

2.3 DIFFERENTIAL PRESSURE TRANSDUCER

A. Monitors differential pressure between rooms for hazard mitigation

B. 4-20mA out put

C. Alarm contacts close < 0.1 psi differential

D. 24vDC

2.4 GENERAL

A. Pressure measuring and control systems shall be handled, installed, calibrated, loop-tested, precommissioned, and performance tested according to Section 40 90 00 – Process Control and Instrumentation Systems.

2.5 INSTALLATION

A. Mounting hardware and sensing lines shall be stainless steel in accordance with Section 22 11 19 – Piping and Tubing Systems and as shown on drawings.

B. Provide Pressure Transmitter for each sewage pump.

END OF SECTION

SECTION 40 90 00 – PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all new Process Control and Instrumentation Systems (PCIS), less programming, complete and operable, and modify the existing PCIS as required in accordance with the Contract Documents. All programming and configuration shall be done by the ENGINEER and OWNER.

B. The requirements of this Section apply to all components of the PCIS, unless indicated otherwise.

C. Responsibilities
   1. The CONTRACTOR, through the use of an Instrumentation Supplier, panel fabricator, and qualified electrical and mechanical installers, shall be responsible to the OWNER for the implementation of the PCIS and the integration of the PCIS with other required instrumentation and control devices.
   2. Due to the complexities associated with the interfacing of numerous control system devices, it is the intent of these Specifications that the Instrumentation Supplier be responsible to the CONTRACTOR for the integration of the PCIS with devices provided under other sections, with the objective of providing a completely integrated control system free of signal incompatibilities.
   3. As a minimum, the Instrumentation Supplier shall perform the following WORK:
      a. Implementation of the PCIS
         1) prepare analog hardware submittals
         2) prepare the test plan, the training plan, and the spare parts submittals
         3) procure hardware
         4) oversee and certify hardware installation
         5) oversee, document, and certify loop testing
         6) prepare Technical Manuals
         7) prepare edited set of record drawings
   4. Any Instrumentation Supplier responsibilities in addition to the list above are at the discretion of the CONTRACTOR and the Instrumentation Supplier. Additional requirements in this Section and throughout Division 40 which are stated to be the CONTRACTOR's responsibility may be performed by the Instrumentation Supplier if the CONTRACTOR and Instrumentation Supplier so agree.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6 and the following:

1. The CONTRACTOR shall coordinate the instrumentation work so that the complete instrumentation and control system will be provided and will be supported by accurate Shop Drawings and record drawings.
2. Exchange of Technical Information: During the period of preparation of these submittals, the CONTRACTOR shall authorize a direct, informal liaison with the ENGINEER for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as indicated may be authorized informally by the ENGINEER, but will not alter the scope of work or cause increase or decrease in the Contract Price. During this informal exchange, no oral statement by the ENGINEER shall be construed to give approval of any component or method, nor shall any statement be construed to grant exception to or variation from these Contract Documents.
3. Symbology and Nomenclature: In these Contract Documents, all systems, all meters, all instruments, and all other elements are represented schematically, and are designated by symbology as derived from Instrument Society of America Standard ANSI/ISA S5.1 – Instrumentation Symbols and Identification. The nomenclature and numbers designated herein and on the Contract 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 Contract Drawings.

B. Shop Drawings
   1. General
      a. Shop Drawings shall include the letterhead or title block of the Instrumentation Supplier. The title block shall include, as a minimum, the Instrumentation 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 MASS Section 10.05 Article 5.6.
      b. Organization of the Shop Drawing submittals shall be compatible with eventual submittals for later inclusion in the Technical Manual.
      c. Shop Drawing information shall be bound in standard size, three-ring, loose-leaf, vinyl plastic, hard cover binders suitable for bookshelf storage. One set of drawings for each facility is to be hung inside the SCADA 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. Analog Hardware Submittal: The CONTRACTOR shall submit an analog hardware submittal as a complete bound package at one time within 60 calendar days after the commencement date stated in the Notice to Proceed, including:
      a. A complete index which lists each device by tag number, type, and manufacturer. A separate technical brochure or bulletin shall be included

with each instrument data sheet (original documents only – photocopies are not acceptable and will be rejected). The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags.

b. Fully executed data sheets according to ISA-S20 – Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, for each component, together with a technical product brochure or bulletin. The technical product brochures shall be complete enough to verify conformance to all Contract Document requirements. The data sheets, as a minimum, shall show:
   1) Component functional description used in the Contract Documents
   2) Manufacturer's model number or other product designation
   3) Project tag number used in the Contract Documents
   4) Project system or loop of which the component is a part
   5) Project location or assembly at which the component is to be installed
   6) Input and output characteristics
   7) Scale, range, units, and multiplier (if any)
   8) Requirements for electric supply (if any)
   9) Requirements for air supply (if any)
   10) Materials of component parts to be in contact with or otherwise exposed to process media and corrosive ambient air
   11) Special requirements or features
c. Priced list of all spare parts for all devices.
d. Instrument installation, mounting, and anchoring details shall be submitted in an electronic hard copy format. Each instrument shall have a dedicated 8-1/2-inch by 11-inch detail which only pertains to the specific instrument by tag number. Each detail shall be certified by the instrument manufacturer that the proposed installation is in accordance with the instrument manufacturer's recommendations and is fully warrantable. These certifications shall be embedded in the CAD files and also appear as a stamp on the hard copies. As a minimum, each detail shall have the following contents:
   1) Show all necessary sections and elevation views required to define instrument location by referencing tank, building or equipment names and numbers, and geographical qualities such as north, south, east, west, basement, first floor.
   2) Process line pipe or tank size, service and material.
   3) Process tap elevation and location.
   4) Upstream and downstream straight pipe lengths between instrument installation and pipe fittings and valves.
   5) Routing of tubing and identification of supports.

6) Mounting brackets, stands, and anchoring devices.
7) Conduit entry size, number, location, and delineation between power and signal.
8) NEMA ratings of enclosures and all components.
9) Clearances required for instrument servicing.
10) List itemizing all manufacturer makes, model numbers, quantities, lengths required, and materials of each item required to support the implementation of the detail.

3. Test Procedure Submittals
   a. The CONTRACTOR 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.
4. The CONTRACTOR shall provide a submittal of the CSPDF's certifications, P.E. licenses, and project history before submitting any Shop Drawings or commencing any work on the control panels.

C. Technical Manual
1. General: Information in the Technical Manual shall be based upon the approved Shop Drawing submittals as modified for conditions encountered in the field during the WORK.
2. The Technical Manual shall have the following organization for each process:
   a. Section C – Edited As-Built Drawings
   b. Section D – Instrument Summary
   c. Section E – Instrument Data Sheets
   d. Section G – Instrument Installation Details
   e. Section H – Test Results
3. Signed results from Loop Testing and FAT test.
4. Initially, two sets of draft Technical Manuals shall be submitted for review after return of favorably reviewed Shop Drawings and data required herein. Following the ENGINEER's review, one set will be returned to the CONTRACTOR with comments. The Manuals shall be revised and amended as required and the final Manuals shall be submitted 15 days prior to start-up of systems.
5. The CONTRACTOR shall provide Instrument Equipment Summary Form 1302 CM 1207 for all instruments, PLC hardware, devices, control hardware, and miscellaneous equipment. The data shall be provided in electronic format, **Microsoft Excel**, or approved equal.

D. Record Drawings
1. The CONTRACTOR shall keep current a set of complete loop and schematic diagrams which shall include all field and panel wiring, piping and tubing runs, routing, mounting details, point to point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and instrument elements. Two sets of drawings electronically formatted in

AUTOCAD on CD-ROM and two hard copies shall be submitted after completion of all commissioning tasks. All such drawings shall be submitted for review prior to acceptance of the completed work by the OWNER.

1.3 WARRANTY

A. The warranty shall start from the date of final acceptance of the completed project, and shall extend for 1 year, in accordance with MASS Division 10.

PART 2 - PRODUCTS

2.1 GENERAL (n/a)

PART 3 - EXECUTION

3.1 INSTALLATION

A. General
   1. Instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 40 and the manufacturers' instructions.
   2. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the OWNER exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the CONTRACTOR shall make such changes without additional cost to the OWNER.

B. Conduit, Cables, and Field Wiring
   1. Conduit shall be provided under Division 26.
   2. Process equipment control wiring, 4-20 mA signal circuits, signal wiring to field instruments, PLC input and output wiring and other field wiring and cables shall be provided under Division 26.
   3. PLC equipment cables, Control Area Networks shall be provided under Division 40.
   4. Terminations and wire identification at PCIS equipment furnished under this or any other Division shall be provided under Division 40.

C. Instrumentation Tie-Downs: Instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements applicable to the Site.

D. Existing Instrumentation: Each existing instrument to be removed and reinstalled shall be cleaned, reconditioned, and recalibrated by an authorized service facility of the instrument manufacturer. The CONTRACTOR shall provide certification of this work prior to reinstallation of each instrument.

E. Ancillary Devices: The Contract Documents show all necessary conduit and instruments required to make a complete instrumentation system. The CONTRACTOR shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements. Such additions and such changes, including the proposed method of installation, shall be submitted to the ENGINEER for approval prior to commencing the WORK. Such changes shall not be a basis of claims for extra work or delay.

F. Installation Criteria and Validation: Field-mounted components and assemblies shall be installed and connected according to the requirements below:
   1. Installation personnel have been instructed on installation requirements of the Contract Documents.
   2. Technical assistance is available to installation personnel at least by telephone.
   3. Installation personnel have at least one copy of the approved Shop Drawings and data.
   4. Instrument process sensing lines shall be installed under Section 22 11 19 – Piping and Tubing Systems.
   5. Flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.
   6. Power and signal wires shall be terminated with crimped type lugs.
   7. Connectors shall be, as a minimum, watertight.
   8. Wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.
   9. Wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices, unless specifically approved by the ENGINEER. Wiring shall be protected from sharp edges and corners.
   10. Fasteners using adhesives are not permitted.
   11. Mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.
   12. Verify the correctness of each installation, including polarity of electric power and signal connections, and make sure process connections are free of leaks. The CONTRACTOR shall certify in writing that discrepancies have been corrected for each loop or system checked out.
   13. The OWNER will not be responsible for any additional cost of rework attributable to actions of the CONTRACTOR or the Instrumentation Supplier.

3.2 CALIBRATION

A. General: Devices provided under Division 40 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Calibration Points: Each instrument shall be calibrated at 20, 60, and 100 percent of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Testing Standards.

C. Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the ENGINEER.

D. Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers.

F. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:
   1. Project name
   2. Loop number
   3. Tag number
   4. Manufacturer
   5. Model number
   6. Serial number
   7. Calibration range
   8. Calibration data: Input, output, and error at 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

G. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the ENGINEER. The CONTRACTOR shall have the Instrumentation Supplier sign the tag when calibration is complete. The ENGINEER will sign the tag when the calibration and testing has been accepted.

3.3 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 CONTRACTOR 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 and at the CONTRACTOR’s expense.

D. Loop Validation: Controllers and electronic function modules shall be field-tested and exercised to demonstrate correct operation of the hardware and wiring. Control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses at register in the PLC processor. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested.

E. Loop Validation Sheets: The CONTRACTOR shall prepare loop confirmation sheets for each loop covering each active instrumentation and control device including simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the 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 or the ENGINEER's representative as a witness, with test data entered, shall be submitted to the ENGINEER together with a clear and unequivocal statement that the instrumentation has been successfully calibrated, inspected, and tested.

3.4 RADIO SYSTEM TEST

A. After the new antenna is installed, confirm radio communication. They will confirm proper operation of the unit and serve as a benchmark in troubleshooting should difficulties appear after the system is placed back in service. These measurements must be performed by a skilled radio-technician and are: Antenna System SWR (Standing-Wave Ratio), and Antenna Direction Optimization, as defined below.

B. Antenna System SWR and Transmitter Power Output

1. General: A proper impedance match between the MDS Entranet 900 radio and the antenna system is important. It ensures the maximum signal transfer between the radio and antenna. The impedance match can be checked indirectly by measuring the SWR of the antenna system. If the results are normal (as defined in the next paragraph), record them for comparison for use during future routine preventative maintenance. Abnormal readings indicate possible trouble with the antenna or the transmission line that must be corrected and the test then repeated.

   The SWR of the antenna system is to be checked before the radio is put into regular service. For accurate readings, a wattmeter suited to 1000 MHz measurements is required. One unit meeting this criterion is the **Bird Model 43** directional wattmeter with a **5J** element installed. The reflected power must be less than 10 percent of the forward power (≈2:1 SWR).

   If the reflected power is more than 10 percent, check the feedline, antenna and its connectors for damage and repair or replace as necessary.

   Set the transmitter power output level to 30 dBm for the duration of the test to provide an adequate signal level for the directional wattmeter.

2. Use the following Microwave Data Systems recommended test procedure:
   a. Place a directional wattmeter between the ANTENNA connector and the antenna system.
   b. Place the MDS unit into the Radio Test Mode.
   c. Set the transmitter power to 30 dBm and turn on the radio transmitter.
   d. Measure the forward and reflected power into the antenna system and calculate the SWR and power output level. The output should agree with the programmed value.

C. Antenna Direction Optimization

1. General: Directional antennas require some fine-turning of their bearing to optimize the received signal strength. The MDS radio has a built-in received signal strength indicator (RSSI) that is to be used to tell when the antenna is in a position that provides the optimum received signal.

   RSSI measurements and Wireless Packet Statistics are based on multiple samples over a period of several seconds. The average of these measurements will be displayed by the radio Management System.

   The measurement and antenna alignment process is expected to take 10 or more minutes.
2. Use the Microwave Data Systems recommended test procedure.
   a. Optimize RSSI (less negative is better) by slowly adjusting the direction of the antenna. Watch the RSSI indication for several seconds after making each adjustment so that the RSSI accurately reflects any change in the link signal strength.
   b. View the Wireless Packets Dropped and Received Error rates at the point of maximum RSSI level. They should be the same or lower than the previous reading. (Main Menu>Performance Information>Packet Statistics>Wireless Packet Statistics)

3.5 PERFORMANCE TEST

A. The entire PCIS hardware, field instruments, power supplies, and wiring shall operate for 30 days without failure.

B. The CONTRACTOR shall furnish support staff as required to satisfy the repair or replacement requirements.

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 SUBSTANTIAL COMPLETION

A. For the purpose of this Section, the following conditions, in addition to the requirements in MASS Division 10, shall be fulfilled before the WORK is considered substantially complete:
   1. Submittals have been completed and approved.
   2. The PCIS has been installed, calibrated, and loop tested.
   3. Spare parts and expendable supplies and test equipment have been delivered to the ENGINEER.
   4. The performance test has been successfully completed.
   5. Punch-list items have been corrected.
   6. Record drawings in both hard copy and electronic format have been submitted.

7. Revisions to the Technical Manuals that may have resulted from the field tests have been made and reviewed.
8. Debris associated with installation of instrumentation has been removed.
9. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.
10. Instrument Equipment Summary Forms 1302 CM-1207 have been accepted by the OWNER.

END OF SECTION

SECTION 40 91 05 – MISCELLANEOUS I&C COMPONENTS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide complete smoke detectors, float switches and solenoid valves as indicated on the electrical drawings, control diagram, herein, or in other Sections of the Specifications.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Components shall comply with the requirements of NEC, NEMA, and shall be UL listed, or equal as approved by the Municipality of Anchorage Building Department.

1.3 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings in accordance with MASS Section 10.05 Article 5.6, and 26 05 00 – Electrical Work, General.
   1. Include panel schematics and layout drawings, and catalog cuts of all I&C control equipment.

PART 2 - PRODUCTS

2.1 GENERAL

A. The CONTRACTOR shall provide the components to satisfy the functional requirements in the relevant mechanical equipment and Instrumentation & Control specifications and the Electrical Schematics. Components not specifically indicated as being WORK of other Sections shall be provided under this Section. All components shall be wired under this Section.

B. The controls shall be 120-volt maximum, preferably 24 VDC. Control conductors shall be provided in accordance with Section 26 05 00 – Electrical Work, General.

2.2 FLOOD DETECTORS

A. Flood Detectors: Flood detection is to be accomplished utilizing single-level liquid level sensors that employ hermetically sealed magnetic reed switch technology. The detector is to have a float made from Burna-N that rides up and down a brass stem. The ‘normally closed’ switching contact is to be rated at 24 VDC, 0.5 A. Flood detectors are to be **Madison M Series model M4300**, or equal. As shpwn on plans:

2.3 Intrusion Detection Switches:

A. Industrial limit switch and lever arm, Allen-Bradley 802T-HP switch with 802MC-W2B lever arm, or equal.

2.4 High Wet Well Float Switch:

A. The float switch shall be a simple level switch that provides a contact on high level. The float body shall be high-density polypropylene and the cable shall be flexible PVC, rated 120 VAC and use in corrosive environments at a temperature range of -20 degrees F to 100 degrees F. The contact shall be a single Form C-type mercury or mercury-free switch. The float switch shall include a Kevlar Cable grip and 20 meters of cable. The switch shall be **Flygt Model ENM-10**, or equal.

2.5 Pump Protection system::

A. The pump sensors and protection modules shall consist of various components of the be the FLYGT 801 End of Waste Water Design.

B. MAS CU 801
   1. The central unit is a hub for information storing, communication, and presentation. There is one central unit for each system and all the base units exchange information continuously with the central unit. The central unit contains a configuration and analysis tool that is accessed by using a standard web browser. The central unit contains the following information about each pump:
      a. Pump data plate
      b. Monitoring channel settings
      c. Service information and service reports
      d. Histograms
         1) Alarm and event log
         2) Measured data for trend graphs
      e. The central unit handles and communicates with up to ten base units.
      f. Approvals • CE • UKCA • CB • UL

C. MAS BU 812
   1. The base unit is a communication gateway between the pump electronic module and the central unit.
   2. The base unit receives status changes of monitored channels from the pump electronic module.
   3. The base unit has inputs and outputs which are used for alarm functions and interlock.
   4. The base unit communicates with the central unit and the pump electronic module.
   5. Approvals • CE • UKCA • CB • UL • CSA

2.6 MAS PEM 811

A. The pump electronic module monitors the pump through connected pump sensors.

B. It communicates digitally with the base unit and has an integrated 3–axis vibration sensor.

C. The pump electronic module contains the following information about each pump: •
   1. Pump data plate
   2. Monitoring channel settings
   3. Service information and service reports
   4. Histograms
      a. Alarm and event log
      b. Measured data for trend

D. Approvals • CE • UKCA • CB • UL • CSA

2.7 FOP 4X2 HMI

A. Touchscreen HMI that is connected to one or more web servers.
   1. The HMI is approved for use in industrial applications. The HMI is installed on a wall or in the cabinet door

2.8 MRM 01

A. The MRM 01 is part of the MAS 801.

B. One or up to eight MRM 01s can be connected to the MAS 801 base unit through RS-485 Modbus.

C. This enables the MAS 801 to communicate individual alarms on the separate monitoring channels to relays and LEDs on one or more MRM 01s.

D. The individual alarms and the summary alarms can connect to a relay.

E. The pump sensors are connected to the pump electronic module in the pump.

F. The pump electronic module monitors the pump. The individual alarms are transmitted to LEDs and relays on the MRM 01.

G. The configuration of what alarm that triggers which relay on which MRM 01 is done in the configuration and analysis tool.

H. Sensor configuration, alarm limits, and more settings are also done in the configuration and analysis tool.

I. Approvals • CE • CSA/US

2.9 SOLENOID VALVE ASSEMBLIES

A. Solenoid valves shall be designed for not less than 0 to 116 psi differential pressure. Enclosures shall be NEMA 4X. All coil ratings shall be 24 VDC, class H insulation, continuous duty. Solenoid valves shall be **ASCO 8320P172**.

B. Connect the solenoid valve to the valve body with a 1/8" x 1-1/2" brass nipple. Provide the following devices:

C. Spares: Provide two (2) spare solenoid valves, only as specified in Paragraph A above.

D. Flood detection is to be accomplished utilizing single-level liquid level sensors that employ hermetically sealed magnetic reed switch technology. The detector is to have a float made from Burna-N that rides up and down a brass stem. The 'normally closed' switching contact is to be rated at 24 VDC, 0.5 A. Flood detectors are to be **Madison M Series model M4300**, or equal. Provide flood detectors as shown in all below grade vaults.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Components shall be installed in accordance with in Section 26 05 00 – Electrical Work, General, and in accordance with the manufacturer's recommendations.

B. Components shall be protected at the Site from loss, damage, and the effects of weather. Stations shall be stored in an indoor, dry location. Heating shall be provided in areas subject to corrosion and humidity.

C. Conduit, conductors, and terminations shall be installed in accordance with Section 26 05 00 – Electrical Work, General.

3.2 FIELD TESTING

A. Each station shall be tested again for functional operation in the field after the connection of external conductors and prior to equipment startup.

B. Deficient stations shall be corrected, to the ENGINEER'S satisfaction, at the CONTRACTOR'S expense.

END OF SECTION

SECTION 40 91 23.36 – LEVEL MEASURING SYSTEMS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall provide level measuring systems, complete and operable in accordance with the Contract Documents.

B. The requirements of Section 40 90 00 – Process Control and Instrumentation Systems apply to this Section.

C. All instruments shall be FM-approved, or equal.

1.2 SUBMITTALS

A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6 and Section 40 90 00 – Process Control and Instrumentation Systems.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE TRANSDUCER TYPE LEVEL MEASUREMENT

A. The level measurement system shall consist of:
   1. A loop-powered, submersible transducer/transmitter, support cord, and interconnecting cable with cable shield and vent tube for atmospheric reference.
   2. The vent tube shall be provided with a replaceable moisture barrier.
   3. The submersible transducer shall be suitable for sensing pressure equivalent to the liquid level range indicated at the specific well depth.
   4. The transducer shall have titanium or 316 stainless steel process wetted parts and shall be provided with a waterproof interconnecting cable.
   5. The transducer shall be suspended by a Kevlar strain relieving cord as provided by the manufacturer.
   6. The installation shall allow easy removal of the transducer and cable assembly for maintenance purposes.
   7. The electronic signal transmitter shall be incorporated in the transducer and shall produce a 4-20 mA DC signal linearly proportional to the operating pressure range.
   8. The physical size of the transducer shall be no more than 8 inches long and 0.7 inch in diameter.
   9. The interconnecting cable shall have a pull strength of 200 pounds, be factory attached to the transducer, and shall be terminated in a weatherproof enclosure furnished.

10. The measurement system shall be rated NEMA 6 for operation over a temperature range of -5 to 140 degrees Fahrenheit with an accuracy of plus or minus 0.5 percent of span.
11. Provide an additional 80 feet of cable with the level sensor.
12. Sensor range shall be factory calibrated for 0-50 Ft.

B. Submersible level transducers/transmitters for waste water service shall be **U.S. Filter Model A1000i**, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Level measuring systems shall be handled, installed, calibrated, loop-tested, precommissioned, and performance tested according to Section 40.90.00 – Process Control and Instrumentation Systems.

3.2 INSTALLATION

A. The submersible transducer interconnecting cable is to be terminated in a weather/explosion proof junction box that is to be mounted on the pump building. The junction box is to contain DIN rail mounted terminals for the transducer and float (3 conductors), float is specified elsewhere.

B. Float cable is to terminate at the junction box.

C. Provide cable mounting kit and 30 feet of 1/8” 7x19 stainless steel cable for support.

D. Install the submersible level transducer in accordance with the Manufacturer’s requirements.

END OF SECTION

SECTION 40 95 00 – PAC-BASED CONTROL SYSTEMS HARDWARE

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR, through the use of the Instrumentation Supplier and qualified electrical installers, shall provide and install the PAC-based control system (PACS) hardware complete and operable, in accordance with the Contract Documents.

B. Instrumentation Supplier: It is the intent of these Specifications to have the Instrumentation Supplier be singularly responsible for selecting, and verifying correct operation of compatible hardware to provide a functional PACS and to provide future support of all PACS hardware.

C. Minimum Instrumentation Supplier Scope: The exact contractual relationship and scope definition shall be established exclusively between the CONTRACTOR and the Instrumentation Supplier. It is the intent of these Specifications that the Instrumentation Supplier, under the direction of the CONTRACTOR, shall assume full responsibility for the following, as a minimum:
   1. Procurement of all hardware required to conform to these Specifications.
   2. Design and submit PACS hardware, and spare parts submittals.
   3. Perform all required PACS hardware tests, adjustments, and calibrations.
   4. Furnish all required PACS tools, test equipment, spare parts, supplies, operations and maintenance manuals, and reproducible record drawings as specified herein.

1.2 SUBMITTALS

A. Shop Drawings: PACS hardware submittals shall be in accordance with the applicable requirements of Section 40.90.00 – Process Control and Instrumentation Systems. PACS submittals shall, however, be made separately from other process control and instrumentation system submittals.

B. Hardware Submittals: The PACS hardware submittal shall be a single submittal which includes at least the following:
   1. A complete index appearing in the front of each bound submittal volume. System groups shall be separated by labeled tags.
   2. Complete grounding requirements for the entire PACS, including any requirements for PACS communication networks and control room equipment.
   3. Data sheets shall be included for each PACS component together with a technical product brochure or bulletin. These data sheets shall show the component name as used within the Contract Documents, the manufacturer's model number or other identifying product designation, the project tag number, the project system of which it is a part, the Site to which it applies, the input and output characteristics, the requirements for electric power, the ambient operating condition requirements, and details on materials of construction.

4. Complete and detailed bills of materials: A bill of material list, including quantity, description, manufacturer, and part number, shall be submitted for each component of the PACS system. Bills of material shall include all items within an enclosure.

C. Owner's Manuals: General requirements for Owner's Manuals are as described in Section 40.90.00 – Process Control and Instrumentation Systems. The following items shall also be included in the PACS manual:
   1. Operation and maintenance manuals for both the PACS, and all other PACS hardware.

D. Factory Test Procedure: The Instrumentation Supplier shall prepare and submit a factory test procedure which incorporates test sequences, test forms, samples of database lists, a PACS testing block diagram, and an estimated test duration which comply with the requirements of the factory test specified herein.

1.3 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The CONTRACTOR/Instrumentation Supplier shall arrange for visits by, and services of, technical field representatives of the PAC manufacturer for installation certification, system testing, and start-up. These services shall be part of the WORK.

1.4 STORAGE AND HANDLING

A. All equipment and materials delivered to the Site shall be stored in a location that shall not interfere with the operations of the OWNER's personnel or interfere with construction. Storage and handling shall be performed in a manner that shall afford maximum protection to the equipment and materials. It is the CONTRACTOR's responsibility to assure proper handling and on-site storage.

1.5 SPECIAL WARRANTY REQUIREMENTS

A. Equipment and materials selected by the CONTRACTOR that do not achieve design requirements after installation shall be replaced or modified by the Instrumentation Supplier to attain compliance. The cost for doing so shall be the CONTRACTOR's responsibility. Following replacement or modification, the CONTRACTOR shall retest the system and perform any additional procedures needed to place the complete PACS in satisfactory operation and attain design compliance approval from the ENGINEER.

B. The CONTRACTOR warrants/guarantees the satisfactory performance of the equipment and materials under operating conditions for a period of 1 year after the date of final acceptance of the entire PACS. In the event that tests and inspections disclose latent defects or failure to meet the specified requirements, the Instrumentation Supplier, upon notification by the OWNER, shall proceed at once to correct or repair any such defects or non-conformance or to furnish, at the delivery point named in the Contract Documents, such new equipment or parts as may be necessary for conformity to the requirements, and shall receive no additional

compensation therefore. In case of any required repairs or other corrective or remedial work covered under warranty, the warranties on all such corrections, repairs, new equipment, or parts shall be extended for an additional 24 months from the date of final acceptance, or 12 months from the date of completion of any such corrections, repairs, new equipment, or parts, whichever date is later. If the OWNER performs repair, the CONTRACTOR shall reimburse the OWNER for all costs incurred in the removal of the defective material and installation of the replacement.

PART 2 - PRODUCTS

2.1 GENERAL

A. The requirements of Section 40.90.00 – Process Control and Instrumentation Systems apply to this Section.

B. All materials and all PACS equipment furnished under this Contract shall be new, free from defects, of first quality, and produced by manufacturers regularly engaged in the manufacture of these products.

C. Hardware Commonality: Where there is more than one item of similar equipment being furnished all such similar equipment shall be the product of a singular manufacturer.

2.2 PACS ENCLOSURES

A. Each PAC and its corresponding I/O modules, power supply module(s), communication interface device(s), peripheral equipment, and radio communications shall be mounted inside existing enclosures. All I/O wiring from the field to the I/O modules shall be terminated on terminal blocks in the enclosure.

2.3 UNINTERRUPTIBLE DC POWER SUPPLY

A. Provide and install battery supported DC power supplies of the size, number, and location as shown on the Drawings.

B. The DC power supply shall be per Section 26 33 05 – DC Power Supply/Battery Charger.

2.4 PROGRAMMABLE AUTOMATION CONTROLLER (PAC)

A. General: Each PAC shall be of solid-state design. All central processor (CPU) operating logic shall be contained on plug-in modules for quick replacement. Chassis-wired logic is not acceptable. The controller shall be capable of operating in a hostile industrial environment and designed to provide high reliability specifically in this process application. The internal wiring of the controller is to be fixed, with the logic functions it must perform in a given application to be programmed into its memory. The controller shall be supplied with the CPU, input/output scanner, inputs,

outputs, memory, power supply, and all power and interface cables necessary to function as a complete and operable PAC system.

B. Design: Each PAC shall have all of the facilities required to implement the control schemes and database indicated. PACS shall have the following functions and features:
   1. Modular, field-expandable design allowing the system to be tailored to this process control application. The capability shall exist to allow for expansion of the system by the addition of hardware and/or user software.
   2. The processor plus input and output circuitry shall be of a modular design with interchangeability provided for all similar modules. Modules are defined herein as devices that plug together to form an interlocking modular chassis. The design must prohibit upside-down insertion of the modules.
   3. The PAC shall have downward compatibility whereby all new module designs can be interchanged with all similar modules in an effort to reduce obsolescence.
   4. All hardware shall operate at an ambient temperature of 0 to 60 degrees C (32 to 140 degrees F), with an ambient temperature rating for storage of - 40 to + 85 degrees C (- 40 to + 185 degrees F), and shall function continuously in the relative humidity range of 5 percent to 95 percent with no condensation. The PAC system shall be designed and tested to operate in the high electrical noise environment of an industrial plant.
   5. The PAC shall provide a means for mounting the chassis in a standard cabinet.

C. Central Processors: The CPU shall contain all the relays, timers, counters, number storage registers, shift registers, sequencer, arithmetic capability, and comparators necessary to perform the indicated control functions. It shall be capable of interfacing sufficient discrete inputs, analog inputs, discrete outputs, and analog outputs as shown on the drawings. The Processor shall be an **Allen Bradley CompactLogix 1769-L33er**, as shown on the Drawing, no exceptions, to match AWWU equipment at other AWWU facilities. The CPU shall be supplied with a 1GB **SecureDigital card Allen-Bradley 1784-SD1**, or equal. The PACS shall have the following features and capabilities:
   1. All PACS shall be provided to support and implement closed loop floating and PID control which is directly integrated into the PAC's control program.
   2. The CPU shall be a self-contained unit, and shall provide control program execution and support remote or local programming. This device shall also supply I/O scanning and inter-processor and peripheral communication functions.
   3. The operating system shall be contained in removable programmable devices which allow for easy field replacement.
   4. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a "green" indicator when no fault is detected and a "red" indicator when a fault is detected.
   5. Non-volatile memory shall store the operating system information to protect against loss in the case of power loss or system shut-down. Only at the time of a hardware change shall this configuration status be altered or re-entered.
   6. The PAC shall have the ability to fit into Rockwell’s Factory Talk Directory’s Security Application and participate in the Rockwell Asset Center Disaster Recovery Program.

D. Program Creation and Storage (Memory)
   1. The program storage medium shall be of a static RAM type.
   2. The PAC system shall be capable of addressing up to 2MB, where each word is comprised of 8 data bits.
   3. Memory capacity shall be configurable to allow for the most economical match to the intended application. It shall be possible to upgrade to a processor with a larger memory size simply by saving a program, replacing the processor, and downloading the program to the new system without having to make any program changes.
   4. Memory shall be capable of retaining all stored program data through a continuous power outage for 4 months under worst case conditions. A low battery condition must be detectable in ladder logic, but shall not automatically generate a major fault.
   5. All user memory in the processor not used for program storage shall be allocatable from main memory for the purpose of data storage. The PAC system shall be capable of storing the following data types:
      a. External Output Status
      b. External Input Status
      c. Timer Values
      d. Counter Values
      e. Signed Integer Numbers (16-bit)
      f. Floating Point Numbers
      g. Decimal Numbers
      h. Binary Numbers
      i. BCD Numbers
      j. Direct and Indexed Addressing
      k. Internal Processor Status Information
      l. ASCII Character Data
      m. ASCII String Data
      n. Block Transfer Control Structures
      o. Floating Point PID Control Structures
      p. File Instruction Control Structures
      q. Message Control Structures
   6. Control logic programs shall have immediate access to the sub-elements of control structures by address and sub-element mnemonic, such as timer accumulator value, timer done bit, or PID Process Variable value.
   7. Each unit shall be supplied with memory to implement the indicated control functions. The memory shall be programmed in a multi-mode configuration with multiple series or parallel contacts, counters, timers, and arithmetic functions.

E. Programming Techniques: The ENGINEER and OWNER shall program the PACS.

F. Ethernet Interface and Network
   1. The PAC system shall offer industry standard Ethernet TCP/IP communication capabilities. The controller shall be able to connect to industry standard 100baseT media types by implementing a standard RJ-45 transceiver port that can connect to different transceivers. There shall be a CIP protocol layer that

uses TCP/IP as the transport mechanism to deliver packets of data to other PACS that use the same protocol. This protocol handles the addressing and transfer of all the specific data file types in the PAC to allow for peer-to-peer messaging.

a. Token passing system.
b. Peer-to-peer communication.
c. Message error checking.
d. Retries of unacknowledged messages.
e. Diagnostic checks on other stations.
f. Interface to more than one network.
g. A user-oriented command language for manipulation of data structures of variable size and organization, such as setting or resetting bits, word and file transfers in a peer processor.
h. The ability to perform PAC memory uploads and downloads.
i. The ability to communicate with all other models of PAC manufactured by said manufacturer.
j. The ability to monitor the status of any processor remotely via the network.
k. The ability to automatically broadcast data to (and receive data from) all compatible stations on the link. Once configured, this operation shall be continuous without operator intervention.
l. A gateway interface to the Ethernet TCP/IP network for connectivity to host computers as well as other PACS that have direct Ethernet connectivity

2. The PAC system shall allow industry standard repeaters, bridges, routers, and gateways on the network in order to access other PACS and host computers. The controller shall be able to name a specific gateway/router IP address in order to direct data to other networks.
3. On-line programming and upload/downloads of control programs shall be able to occur over the Ethernet network.

G. PAC Power Supply

1. The PAC shall operate in compliance with an electrical service of 24 VDC. The power supply shall be mounted in the PAC housing and be sized to power all modules mounted in that housing and an "average module load" for any empty housing slots plus 25 percent above that total. Power supply shall be by the same manufacturer as the PAC and shall be of the same product line. A single main power supply shall have the capability of supplying power to the CPU and local input/output modules. Auxiliary power supplies shall provide power to remotely located racks.
2. The power supply shall be **Allen-Bradley 1769-PB4**, no exceptions to the model shown on the Drawings.

H. PAC Input/Output (I/O) Modules

1. I/O Modules General: All I/O housings and modules shall be suitable for hostile industrial environments. All I/O modules shall be isolated and conform to IEEE Surge Withstand Standards and NEMA Noise Immunity Standards. The I/Os shall be 4-20 mA DC for all analog inputs and outputs and shall be 24 VDC for discrete inputs and dry relay contacts for safe discrete outputs. Each PAC I/O

location shall contain the I/O module quantity and type as shown on the Drawings.

2. Discrete Input Modules with Diagnostics: Defined as contact closure inputs from devices external to the programmable controller module. Individual inputs shall be optically isolated from low energy common mode transients to 1500 volts peak from users wiring or other I/O modules. Input modules shall be **Allen-Bradley 1769-IQ16** or **1756-IB16**, unless noted on the Drawings.
   a. DC input for devices that operate at 5 to 30 VDC.
3. Discrete Output Modules with Electronic Fuse: Defined as contact closure outputs for ON/OFF operation of devices external to the programmable controller module. The output modules shall be optically isolated from inductively-generated, normal mode and low energy, common mode transients to 1500 volts peak. Discrete output contacts shall be provided with interposing relays in the control panel. Output modules shall be **Allen-Bradley 1769-OB16** or **1756-OB16**, unless noted on the Drawings.
   a. DC output for devices that operate at 10 to 30 VDC.
4. Analog Input Modules: Defined as 4 to 20 mA DC signals, where an analog to digital conversion is performed with 14-bit precision and the digital result is entered into the processor. The analog to digital conversion shall be updated with each scan of the processor. Input modules shall be source or sink to handle 2-wire or 4-wire transmitters, respectively. Input modules shall be **Allen-Bradley 1769-IF4** or **1756-IF16**, unless noted on the Drawings.
5. Analog Output Modules: Defined as 4 to 20 mA DC output signals where each output circuit performs a digital to analog conversion minimum of 12-bit precision with each scan of the processor. Each analog output module shall have two isolated output points which shall be rated for loads of up to 1200 ohms. The CONTRACTOR shall provide current loop isolators as required to break ground loops. Output modules shall be **Allen-Bradley 1769-OF2** or **1756-OF8**, unless noted on the Drawings.
6.

I. PAC Rack Configuration: The PAC, power supply, and I/O modules shall be mounted in the Rack configurations show on the drawings. Space is to be provided for future expansion of the racks in keeping with Allen-Bradley guidelines.

J. Operator Interface: A color LCD, touch sensitive, Operator Interface is to be provided at each facility to allow local display. The unit is to be supplied at 24 VDC and is to communicate to the PAC via an Ethernet interface. The Operator Interface shall be **Allen-Bradley model Panel View Plus 5510 2715P series** no exception.

2.5 NETWORK HARDWARE

A. All unshielded twisted pair cabling shall be rated EIA/TIA 568 category 5 for plenum space.

B. DIN Rail-mounted Ethernet Switch: The switch shall be compact size and designed to mount to DIN rail, be 10Base-T/100Base-TX compliant, be Auto sensing full and half duplex, have 6 to 10 ports as shown, and have a UL 508 listing. The power supply shall be 8 VDC to 24 VDC. The switch shall be **STRATIX 5700**, or equal. The

ENGINEER has tested this switch and is satisfied that it will function in the SCADA system as intended.

C. EtherNet / IP Distributed I/O Module: Allows CompactLogix user to re-use existing 1769 I/O. **Allen-Bradley-AENTR I/O Module.**

D. EtherNet Tap Module: **Allen-Bradley 1783-ETAP**.

2.6 REMOTE I/O EXPANDER

A. As shown on the plans.

2.7 SPARE PARTS

A. Provide one card, power supply, radio, and switch of each type as required to be installed in the SCADA panel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall utilize qualified personnel to accomplish, or supervise the physical installation of all elements, components, accessories, or assemblies that it provides. The CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all elements, components, accessories, and assemblies it provides.

B. All components of the PACS, including all communication cabling, shall be the installation responsibility of the CONTRACTOR unless specifically noted otherwise. The installation of the communication network shall be the complete installation responsibility of the CONTRACTOR, including all cables, connectors, transceivers, antennas, and any required electrical grounds. Grounding shall be shown on submittal drawings. After installation of the PACS is completed, the installation shall be inspected jointly by the CONTRACTOR and the Equipment Manufacturer's representatives. Any problems shall be corrected, and when both are satisfied with the installation, a written certification of the installation shall be delivered to the ENGINEER. The certification shall state that all PAC communication and I/O modules, modems, system grounds, communication network, and all other components of the PACS System have been inspected and are installed in accordance with the Manufacturer's guidelines.

3.2 FACTORY TEST

A. General: Prior to shipment of the PACS from the factory, but after the procurement, assembly, and configuration of all components, the CONTRACTOR shall conduct a factory test on the panel fabricator shop floor. This test shall be witnessed by a representative of the OWNER and the ENGINEER of record, at the place of

fabrication. No PACS shall be shipped without the ENGINEER's written approval of the factory test. The factory test is intended to be a complete PACS. The factory test shall demonstrate the functionality and performance of specified features of the PAC. The test shall include verification of all radios, PACS, and remote I/O system I/O points. Each point shall be checked from the terminal strip to register in the PAC processor. A complete system checklist shall be available during the test for recording results of selected points. **A minimum of ten (10) working days'** notification shall be provided to the ENGINEER prior to testing.

B. Test Setup: The complete PACS system as shown on the drawings shall be assembled and interconnected on the CONTRACTOR's factory floor. The system shall include communication cable segments for the LANs, an Ethernet switch provided by the CONTRACTOR, and the radios to simulate as closely as possible the eventual Site installation. The PACS and communication devices shall be loaded with their applicable software packages. PAC input and output modules shall be installed in their assigned housings and wired to field termination points in the enclosures. The CONTRACTOR shall have a complete, up-to-date set of wiring drawings and a PAC register list for the test point, for review throughout the test.

C. The CONTRACTOR shall schedule the factory test after receiving approval of the factory test procedures submittal. One test shall be conducted for the complete system. A minimum of five 8-hour days will be required for the test. The CONTRACTOR shall provide a qualified technician to assist with testing for the entire duration of the factory test.

D. Test Procedure: The factory test shall be conducted in accordance with the previously submitted and approved test procedures. The test procedures shall include written descriptions of how individual tests shall be performed and shall incorporate testing the following features as a minimum. All testing shall be completed in one continuous factory test which shall extend over 5 continuous days.
   1. Power Failure: External power to enclosures and/or workstations shall be turned off and back on in order to test the operation of the DC battery back-up system.
   2. The panel fabricator shall provide one technician for the 5 days of the test to assist the ENGINEER in testing the panel.

E. Test Report: The CONTRACTOR shall record the results of all factory testing on preapproved test forms which the OWNER's and ENGINEER's representatives shall sign. A copy of the completed test forms and a report certifying the results shall be provided to the ENGINEER within 10 days of completing the test.

F. Rework and Retest: If the PACS does not operate as required, the CONTRACTOR shall make whatever corrections are necessary, and the failed part of the tests shall be repeated. If, in the opinion of ENGINEER's representative, the changes made by the CONTRACTOR for such a correction are sufficient in kind or scope to effect parts of system operation already tested, then the effected parts shall be retested also. If a reliable determination of the effect of changes made by the CONTRACTOR cannot be made, then the ENGINEER's representative may require that all operations be retested. The CONTRACTOR shall bear all of its own costs for the factory test, including any required retesting.

G. All of the travel and per diem costs for factory testing and retesting shall be borne by the CONTRACTOR.
   1. For factories within a 50-mile radius of the project site, no travel or per diem costs will be charged by the OWNER's representative and ENGINEER of record.
   2. For factories outside of a 50-mile radius of the project site, the CONTRACTOR shall pay air travel costs, vehicle rental costs, lodging, and meals, for two people for the duration of each visit required to witness the factory tests. The vehicle rental, lodging, and meal allowance shall be $175 per person per day.

3.3 CALIBRATION, TESTING, AND INSTALLATION

A. Calibration: All analog inputs and outputs of the PAC shall have their calibration checked at a minimum of two points to verify consistency with the balance of the analog loop. This calibration check shall be done in conjunction with the analog loop tests in Section 40.90.00 – Process Control and Instrumentation Systems. Operator Interfaces and PAC registers shall both be verified for correctness.

B. The CONTRACTOR shall submit to the ENGINEER a system testing completion report when each process system and all aspects of the configuration software have been successfully tested as described herein. The report shall note any problems encountered and what action was required to correct them. It shall include a clear and unequivocal statement that the process systems have been thoroughly tested and are complete and functional in accordance with all Specification requirements.

END OF SECTION

SECTION 40 95 13 – CONTROL PANELS AND PANEL MODIFICATIONS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall provide control panels and all modifications to existing control panels, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 90 00 – Process Control and Instrumentation Systems apply to this Section.

C. The provisions of this Section apply to local panels provided in equipment systems specified in other sections, unless indicated otherwise in those sections. Modifications to existing control panels and onsite equipment shall conform to the requirements of this specification. This specification will include:
   1. Modifications of the existing SCADA system
      a. Main SCADA Panel
      b. Auxiliary SCADA I/O panel
      c. Power Supply Panel
   2. Pump Control Panel LCP-301, -302, -303 and -304
      a. The enclosures for these panels have been installed and used for pull boxes to support the existing pump installation.
      b. The Pump Control enclosures are 16x20x10, NEMA 4 steel, UL Listed
      c. Contractor shall be required to construct back panel and door assemblies for use with the existing panels.
   3. Panel LCP-300 Remote I/O Expansion
      a. The enclosure for this panel has been installed and is currently used as a pull box to support the existing pump installation.
      b. The Pump Control enclosures are 16x20x10, NEMA 4 steel, UL Listed
      c. Contractor shall be required to construct back panel and door assemblies for use with the existing panels.
   4. Terminal Cabinet TC-300
      a. This enclosure is currently being used as a pull box in support of the current pump controls.
      b. Provide new backboard and terminals for all of the circuits passing through this location.
   5. Intrinsically safe barrier panel LCP-500
      a. Provide suitable NEMA 12 enclosure with power supply and intrinsically safe (3) ANALOG CHANNELS for the (2) level transmitters LT-401 and LT 402, and the combustible gas detector AIT 367
      b. (2) DIGITAL CHANNELS for High Level alarm float LSHH-103 and the combustible gas detector AIT 367 LEL alarm.

6. All enclosed auxiliary instrumentation and controls not listed as an assembly from the manufacturer.

D. Industrial Control panels shall be constructed in accordance with Underwriter's Laboratories requirements for Industrial Control panels (UL508A) and other applicable standards as required to comply with the electrical requirements stated in the project plans and specifications. All panels shall be built by a control panel fabrication shop that maintains current certification by a Nationally Recognized Testing Laboratory (NRTL) acceptable to the State of Alaska and the United States Occupational Safety and Health Administration (OSHA). The fabricator shall construct the equipment in accordance with the applicable standard(s), test the equipment as defined in the standard and label the final assembly in accordance with the requirements of the NRTL and the applicable construction standard(s). A list of NRTL organizations acceptable to the State of Alaska and OSHA can be found at the following location:

https://www.osha.gov/dts/otpca/nrtl/nrtllist.html

E. Panels for installation in hazardous locations and/or containing intrinsically safe circuits shall be constructed in accordance with ANSI/ISA 12.12, UL698 and UL698A as applicable.

F. Modifications to existing control panels shall be performed in accordance with Underwriter's Laboratories requirements for Industrial Control panels (UL508A) and other applicable standards as required to comply with the electrical requirements stated in the project plans and specifications. The panel builder shall provide a 3rd party field evaluation after completion of all on-site modifications to existing controls panels and equipment. Field evaluation shall be performed by an NRTL acceptable to the State of Alaska and OSHA. The report resulting from the field evaluation shall be provided to the owner at the completion of the evaluation. Non-compliance items identified by the field evaluation that fall outside the scope of work as defined in the plans and specifications shall be addressed by the owner.

1.2 REFERENCE DOCUMENTS

A. UL 508A – Standard for Industrial Control Panels

B. NFPA 79 – Electrical Standard for Industrial Machinery

C. NFPA 70 – Article 409

1.3 SUBMITTALS

A. General: Submittals shall be furnished in accordance with MASS Section 10.05 Article 5.6.

B. Control Panel Engineering Submittal: The CONTRACTOR shall submit a control panel engineering submittal (CPES) for each control panel and/or control panel modifications provided under Division 40. The CPES shall completely define and

document the construction, finish, fuses, circuit breakers, internally-mounted hardware, communications hardware, and PLC 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.Completed ISA S20 data sheets for all instrumentation devices associated with each control panel supplemented with manufacturer specification sheets which verify conformance to the requirements of the Contract Documents.
5. A bill of material which enumerates all devices associated with the control panel.

PART 2 - PRODUCTS

2.1 GENERAL

A. Environmental Suitability: All 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 as shown on the Drawings in order to maintain all instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. The CONTRACTOR shall provide all power wiring for these devices. Enclosures suitable for the environment shall be provided. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

B. Panel construction shall conform to NFPA 70 (NEC) Article 409 and NFPA 79.

C. The control panel controls shall be 24 VDC. Control conductors shall be provided in accordance with the indicated requirements.

D. All equipment associated with the control panel shall be ready for service after connection of conductors to equipment, controls, and control panel.

E. 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 12.
   2. All control or relay panels mounted below ground level, unless noted otherwise on the Drawings, shall be NEMA 4X.

F. Each source of 'external' voltage shall be isolated by providing 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,

G. Motor starters, where required, shall be in accordance with Section 26 24 19 – Low Voltage Motor Control Centers. Each motor starter shall be provided with PLC interface circuits as indicated on the drawings. Electrical components shall be of standard American manufacture.

H. Discrete outputs from the control panels shall be provided by electrically isolated contacts rated for 2 amps at 24 VDC or 5 amps at 120 VAC.

I. All control panel mounted devices shall be provided as shown on the Drawings.

J. Painting: Steel control panels shall be thoroughly cleaned and sand blasted per Steel Structures Painting Council Specification SSPC SP 6 (Commercial Blast) after which surfaces shall receive a prime coat of **Amercoat 185**, or equal, 3 mils DFT, for a total thickness of the prime plus finish system of 6 mils. The finished color of the outside surfaces shall be ANSI 61 gray paint. Interior of the control panel, back-panel, and side-panels shall have a white finish coat.

2.2 CONTROL PANELS

A. NEMA 4X
   1. Enclosure shall be 16-gauge or 14-gauge thickness, unless otherwise indicated on the Drawings, Type 304 or 316L stainless steel.
   2. Enclosures shall have stainless steel hinges, hinge pins, and door clamps.
   3. Finish shall be unpainted, smooth #4 brushed finish, as specified for steel control panels.
   4. Enclosures and Panels shall be as manufactured by **Hoffman**, or equal.

B. NEMA 12

1. Steel panel section faces shall be No. 14 gauge minimum thickness, unless otherwise indicated on the Drawings. All materials shall be selected for levelness and smoothness.
2. Structural shapes and strap steel shall comply with ASTM A 283 – Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C.
    a. Bolting Material: Commercial quality carbon steel bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex end machine bolts. Nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. All other bolted joints shall have SAE standard lock washers.
3. Construction: Dimensions shall be as shown on the Drawings.
4. Enclosures and Panels shall be as manufactured by **Hoffman**, or equal.
5. Fabrication End plates, top plates, and top closure panels (to hung ceiling) shall be provided when required by the material requisition. End plates, top plates, and top closure panels shall be removable with countersunk bolts to match panels. Top closure panels shall be furnished in lengths that match the widths of standard panels, except that one top closure panel may extend across two 4 feet 6 inches wide or five 2 feet wide standard panels. The vertical joints of these panels shall align with the vertical joints of the standard panels.
6. Doors shall be flush-fitting, gasketed, and be of the hinged type with door handles. Screwdriver 1/4 turn or Dzus type fasteners are not acceptable.
    a. The flanged edges of all panels shall be straight and smooth. Corners shall be welded and ground smooth.
    b. The face of the panel shall be true and level after flanging.
    c. All panel cut outs and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.
    d. Adjacent panels shall assemble with faces flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.
    e. Stiffeners shall be welded to the back of panels, as required to prevent panel deformation due to the weight of face-mounted instruments.
    f. Panels shall be self-supporting as defined below.

C. Framework and Supports
1. The rear of each panel section shall have a steel framework assembled to it for supporting conduit, wireways, switches, piping, and all instrument accessory items such as relay or terminal enclosures, transducers, pressure switches, valves, and air relays. The main framework shall be constructed of standard structural shapes. Special shapes such as "Unistrut" may be used for secondary supports. Framework must neither interfere with instrument connections nor interfere with access needed for maintenance or adjustments.
2. Steel framework shall extend 2 feet 4 inches back from the panel face, or as indicated in the material requisition. Where indicated, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel is self-supporting.

D. Preparation of Panel Surface

1. The following requirements apply to the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cut outs.
    a. All high spots, burrs, and rough spots shall be ground smooth. The surfaces shall be sanded or sandblasted to a smooth, clean, bright finish.
    b. All traces of oil shall be removed with a solvent.
    c. The first coat of primer shall be applied immediately.

E. Instrument Finishing: The final coats applied to painted surface of instrument cases, doors, or bezels that are visible from the front of panels shall be manufacturer's standard, unless otherwise indicated. Black japan or "crinkle" finishes on instrument cases are not acceptable.

F. 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.

G. Electrical Requirements
1. The CONTRACTOR shall provide conduit, wireways, switches, wire, and electrical fittings for all 24 VDC 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 400 VAC, manufactured by **Entrelec**, or equal.
4. Each panel shall be provided with a switched L.E.D. style light fixture, as shown on the Drawings.
5. 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.
6. 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 shallbe No. 16 AWG Type MTW rated for 300 volts. The analog wirings between the PLC I/O card and terminal strips shall be No. 18 AWG MTW rated 300 volts. DeviceNet cable shall be as per Allen-Bradley requirements and terminated per Allen-Bradley requirements.
    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 minimum

c. All 120 VAC power wiring protected by the main circuit breaker and incoming power service shall be No. 12 AWG.

d. 3 ground of the 120-volt panel supplying power.

7. Power Supply Wiring

a. Unless otherwise indicated, all instruments, alarm systems, and motor controls shall operate on 24 VDC circuits.

b. The panel fabricator shall provide terminal box connections for the main power supply entry as shown on the Drawings.

H. 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 **Bussman Manufacturing Division, Type KAW TRON**, or equal. Circuit breakers shall be provided as shown on the Drawings.

I. Relays:

1. DIN rail mounted relays shall have contacts rated at 8 amps, 230 volts, at 20,000 operations. The coils shall be 24 VDC at 0.03 amps. Relays shall be **Entrelec model RB121A**, or equal, for single pole, and **RB122** for 5- amp double pole.
2. Battery system test relays shall have contacts rated at 15 amps, 120 VAC, at 150,000 operations. The coils shall be 24 VDC at 0.8 watts. Relaysshall be **Siemens 3TX7110-5JC03** with **3TX7144-1E7** socket.
3. Intrinsic Safety Relay:
   a. The intrinsic safety relay shall provide isolation of 2- wire 24 VDC circuits in a hazardous location.
   b. The safety relays for 4-20 ma analog circuits shall be capable of driving up to a 500-ohm load and pass HART protocol signals to the field devices.
   c. The relays shall be **Turk model MK33**, or equal.

J. Terminals: Fused Terminals for analog input and output points shall be a 3-wire terminal with a fused circuit, a feed through circuit and a ground terminal. 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 blow250-volt fuse for all analog circuits and all discrete input circuits. The analog terminals shall be **Weidmuller model KDKS 1 part 953245**, and the discrete input terminal shall be **Weidmuller model KDKS 1 PE part 953245**.

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
3. 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. 120 VAC Surge Arrestor: A 120 VAC three-stage surge protector shall be provided on the main leads of each panel. The surge protector shall include a first stage inline inductor, a second stage MOV to ground with a thermal fuse, and a third stage array of MOVs to provide a small amount of capacitance. The unit shall be DIN rail-mounted. The MOV shall include green LED to indicate the status of the second stage MOV. Provide two (2) spare units for each panel. The unit shall be rated for 120 VAC and shall be either **Advance Surge Supressor model TSP-WG6-120VAC-10A-01, Control Concepts 'Islatrol Elite' model IE- 110**, or equal.

M. Miscellaneous Parts: Each panel shall be provided with a large steel folding shelf, 12 inches deep by 18 inches wide, **Hoffman model A-ASHLF1218**, or equal, installed on the panel door as shown on the Drawings.

N. Each panel shall be provided with a data pocket holder 1 inch deep by 12 inches wide by 12 inches high, **Hoffman model A-DP2**, or equal, installed on the panel door as shown on the Drawings.

O. Labor and Workmanship: Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

2.3 MARKING

A. At a minimum, control panels shall be marked with the following information that is plainly visible after installation:
   1. Manufacturer's name

SUPPLY VOLTAGE

   2. Short-circuit rating of the assembly
   3. Name of the project and site
   4. Enclosure rating

B. Provide panel labelling in compliance with UL and NRTL requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Preparation for Shipment and Shipping
   1. Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments that are shipped with the panel shall further have

suitable shipping stops and cushioning material installed to protect parts that could be damaged due to mechanical shock. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

2. All control panel factory testing and inspection shall be performed prior to shipping.
3. Control panels shall be installed in accordance with Section 40 90 00 – Process Control and Instrumentation Systems.

3.2 PENETRATIONS

A. All penetrations in underground vaults or NEMA 4X areas shall be bottom entry.

3.3 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. 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.

D. Shop Drawings shall show conformance to the above wiring installation requirements.

E. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number as shown on the Contract Drawings. These numbers shall be marked on all conductors at every termination point using machine printed, heat shrinkable wire labels.

3.4 CALIBRATION, TESTING, AND INSTRUCTION

A. General: Calibration, testing, and instruction shall be performed in accordance with Section 40 90 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.

END OF SECTION

SECTION 43 10 50 – PROCESS PIPING AND VALVES

PART 1 - GENERAL

1.1 THE REQUIREMENT

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. The CONTRACTOR shall provide all piping, fittings, valves, supports, and miscellaneous appurtenances required for a complete and operable system, in accordance with the Contract Documents.

C. 2015 MASS standard construction specifications are to be specifically included as well as all related drawings.

1.2 REFERENCED CODES - LATEST ADOPTED EDITION

A. WORK shall be in full accordance with the latest State and local codes and regulations, including below noted codes and all other local codes. Nothing in the Contract Documents shall be construed to permit WORK in violation of the below noted codes, rules, and regulations.

1. NFPA 70 National Electrical Code (NEC)
2. IMC International Mechanical Code
3. UPC Uniform Plumbing Code
4. IBC International Building Code
5. MASS Municipality of Anchorage Standard Specifications

1.3 SUMMARY

A. Section Includes:

1. Sanitary sewer piping above grade.
2. Unions and flanges.
3. Valves.

1.4 REFERENCES

A. American Society of Mechanical Engineers:
   1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
   2. ASME B16.3 - Malleable Iron Threaded Fittings.
   3. ASME B16.5 – Flanges and Flanged Fittings.

B. American Water Works Association:
   1. AWWA C200 – Steel Water Pipe – 6” and larger.
   2. AWWA C206 – Field Welding of Steel Water Pipe
   3. AWWA C207 – Steel Pipe Flanges for Waterworks Service
   4. AWWA C208 - Dimensions for Steel Fabricated Water Pipe Fittings
   5. AWWA C222 – Polyurethane Coatings for Interior and Exterior of Steel Water Pipe and Fittings
   6. AWWA C213 – Fusion-Bonded Epoxy Coatings for Interior and Exterior of Steel Water Pipe and Fittings
   7. AWWA C509 - Resilient Seated Gate Valves for Water Supply Service
   8. AWWA C550-13 Protective Interior Coatings for Valves and Hydrants

C. ASTM International:
   1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Welded and Seamless.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
   2. MSS SP 81 – Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
   3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.5 SUBMITTALS

A. Submit Shop Drawings in accordance with MASS Section 10.05 Article 5.5.
   1. REQUIRED Submittals:
      a. Shop Drawings: including, but not limited to, all new piping routings and clearances, support locations, valves, and appurtenances.

B. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.
   1. REQUIRED Submittals:
      a. Pipe materials, fittings, and accessories.
      b. Coatings and liners.
      c. Unions and flanges.
      d. Valves.
      e. Hangers and supports.

1.6 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements shall be in accordance with MASS 2015.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with State of Alaska standard and as amended by the Municipality of Anchorage.

B. All piping and fittings shall be subject to inspection in accordance with the provisions of AWWA C200 and AWWA coating and lining standard as supplemented by the requirements herein.

1.8 PROJECT RECORD DRAWINGS

A. In addition to other requirements of MASS 2015, 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 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.

C. Welder: Skilled welders and welding operators who have had adequate experience in the methods and materials to be used shall do all welding. Welders shall maintain current qualifications under the provisions of AWS B2.1 or ASME Section IX. Machines and electrodes similar to those in the work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be in accordance with MASS 2015.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

C. Coated pipe and fittings shall be shipped, handled, and stored so that coating will not be damaged. Coatings that have sustained physical damage, as determined by visual inspection, will be repaired at the Contractors expense prior to installation.

1.11 MATERIALS

A. In accordance with MASS Section 10.05 Article 5.7, all materials and equipment furnished under the Contract shall be new, unless otherwise specified, and shall be of good quality, free from defects, and shall conform to the requirements of the Contract Documents.

B. In accordance with MASS Section 10.05 Article 5.7, substitute materials shall not be used unless approved through the substitution request process by the Engineer in writing prior to installation. 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.

1.12 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.

1.13 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.

1.14 TESTING

A. Testing shall be complete in accordance with MASS Section 10.05 Article 5.8.

B. 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

C. All materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200 and AWWA coating and lining standards.

D. The Contractor shall perform required tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.

1.15 WELDING REQUIREMENTS

A. All welding procedures used to fabricate pipe shall be qualified under the provision of AWS B2.1 or ASME Section IX.

1.16 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.

1.17 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.

1.18 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.

1.19 COMPLETION REQUIREMENTS

A. Project closeout requirements shall be in accordance with MASS 2015; 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.

1.20 WARRANTY

A. Warranty shall be in accordance with MASS Section 10.03 Article 3.7.

B. The Contractor shall warranty all materials and workmanship for two (2) year from the Final Acceptance Date unless otherwise specified in the Special Provisions. This warranty shall require the Contractor to remedy promptly, without cost to the Owner, any and all defects in material and workmanship including any consequential damages resulting from defective materials or workmanship.

C. All warranty Work shall be subject to the same Contract provisions, including materials, quality of work, authority of the Engineer and inspection, as provided for in the original Work. All warranty Work shall be at the sole expense of the Contractor. All materials and workmanship directly or indirectly involved in repairs or replacements shall carry an extended warranty of not less than one (1) year from the date of the Engineer's written acceptance of the repair or replacement Work, or through the warranty period for the original project Work, whichever is longer.

PART 2 - PRODUCTS

2.1 SANITARY SEWER FORCE MAIN

A. Steel Pipe:
1. Less than 6” Diameter: Steel pipe shall be schedule 40, ASTM A53, galvanized.
2. 6” Diameter and larger: Steel Pipe shall be a minimum of schedule 40 conforming to AWWA C200.

B. Fittings:
1. Unless otherwise shown on the Plans, all specials and fittings shall conform to the dimensions of AWWA Standard C208. Pipe material used in fittings shall be of the same material and thickness as the pipe. Fittings shall be equal in pressure design strength All welds made after hydrostatic testing of the straight sections of pipe shall be checked per the requirements of AWWA C-200.

C. Joints:
1. Mechanical Joints: AWWA C200.
2. Flanged Joints: AWWA C207.

D. Coatings:
1. Epoxy coating shall be designed for corrosion protection of metal and meet the requirements of AWWA C213 and C550, to a minimum thickness of 12 mils, measured in accordance with SSPC-PA 2. Lining shall be continuous to the ends of the pipe except where field welding is indicated. 2 coats shall be applied with a minimum total thickness of 24 mils.
2. Inspect, clean and blast surfaces in accordance with manufacturer’s requirements. Solvent clean as necessary to remove any deposits of asphalt paint, oil, grease, soil, drawing and cutting compounds and other soluble contaminants prior to abrasive blasting.
3. Coating Repair - Coating repair for fittings and specials shall be in accordance with the procedure described above for straight-line pipe and as recommended by the manufacturer.
4. Coating material to be epoxy poly-amine coating. Sherwin Williams Fast Clad ER Epoxy or equal.

E. Linings:
1. Polyurethane lined Steel Pipe is to be steel pipe meeting item A of this Article that has been prepared to receive a polyurethane lining. Surface preparation is to be in accordance with the coating manufacturer’s instructions.
2. Polyurethane lining shall be per AWWA C222 to a minimum thickness of 80 mils, measured in accordance with SSPC-PA 2. Lining shall be continuous to the ends of the pipe except where field welding is indicated.
3. Lining repair shall be per AWWA C222 and manufacturer’s recommendations.

4. Lining material is to be Lifelast Durashield 210 or as approved by the Engineer and Utility Company.

2.2 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:
   1. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Victaulic Flanges for Pipe 2-1/2 inches and Larger:
   1. Housing: Hot dipped galvanized.
   2. Gaskets: EPDM gaskets.

2.3 GATE VALVES

A. Manufacturers:
   1. Emerson
   2. DeZurik.
   3. Substitutions: 2015 MASS - Product Requirements.

B. Gate valves shall be stainless steel body, resilient knife gate valves and fully comply with AWWA C509 “Resilient-Seated Gate Valves for Water Supply Service”. Valves shall conform to all applicable parts of AWWA C509 Standard.

C. Where noted on plans 18 inch knife gate valves are to be provided with water actuated cylinders. Cylinders to be rated for a standard duty cycle of 60 PSI to 150 PSI, 10 inch bore size with 1-3/8 inches diameter rod, stroke to be 17.25 inches, provide epoxy coated with adjustable stroke stops and stainless steel construction.

D. Where electric actuators are required for knife gate valves reference specification 25 34 13.13.

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, Structural, and Electrical Drawings. Coordinate work under this section with that of all related trades.

3.2 INSTALLATION

A. All work shall comply with the latest adopted applicable codes and ordinances including, but not limited to, the 2015 MASS, NFPA, IMC, UPC, 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 CUTTING, FITTING, PATCHING AND FINISH

A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where it is necessary to disturb such work to permit installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.

B. Avoid cutting, insofar as possible, by setting sleeves, frames, etc. and by requesting openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for piping.

C. Cut all holes neatly and as small as possible to admit work. Include cutting where sleeves or openings have been omitted. Perform cutting in a manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.4 EXAMINATION

A. 2015 MASS - Administrative Requirements: Coordination and project conditions.

3.5 PREPARATION

A. Remove scale and dirt, on inside and outside, before assembly.

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

3.6 INSTALLATION - PIPING

A. Installation of mechanical joints and flanged joints shall comply with the manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom. Do not spread piping, conserve space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Prior to installation, valves shall be cleaned of all foreign matter and inspected for damage. Valves shall be fully opened and closed to ensure that all parts are properly operating.

H. Provide access where valves and fittings are not accessible.

3.7 FIELD QUALITY CONTROL

A. All field inspecting, testing, and adjusting shall be in accordance with 2015 MASS.

B. The Contractor is to provide all materials, equipment and labor related to testing that is acceptable to the Engineer and Utility Company. Testing, retesting, and any required repairs to pass testing of the installed sewer pipe is an obligation of the Contractor to perform and is incidental to the bid item under construction. After testing, if repairs are needed then the previous testing will considered void and the segment of pipe in which the repair took place is to be retested.

C. The Contractor may test any portion of the installed sewer pipe at any time for their convenience, but acceptance testing is to be performed in the presence of the Engineer or Inspector and a Utility Company representative. The Engineer will provide the Contractor written confirmation that acceptance testing is satisfactory.

D. The Contractor is to clean and flush all sanitary sewer pipe installed prior to testing and substantial completion inspection.

END OF SECTION

SECTION 43 23 13 – SUBMERSIBLE WASTEWATER PUMP MOUNTED IN DRY PIT

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to install, place in operation and field test dry pit mounted submersible wastewater pumps as specified herein and as shown on the Drawings.

B. The CONTRACTOR shall furnish four (4) non-clog, submersible sewage pumps for installation in a dry-well.

C. The heavy-duty submersible wastewater pumps shall be capable of handling raw unscreened sewage, storm water, and other similar solids-laden fluids without clogging. The pumps shall be driven by a Premium Efficiency motor, providing the highest levels of operational reliability and energy efficiency.

1.2 SUBMITTALS

A. Submit Product Data in accordance with MASS Section 10.05 Article 5.6.

B. Submittals shall include at least the following:

1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

2. Descriptive literature, bulletins and/or catalogs of the equipment.

3. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves, based on actual shop tests, which show that they meet the specified requirements for head, capacity, efficiency, NPSHR and horsepower. Curves shall be submitted on 8-1/2" x 11" sheets at as large a scale as is practical. Curves shall be plotted from no flow at shut-off head to pump capacity at minimum specified total head.

4. The total weight of the equipment.

5. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, control panels, starters and related systems.

6. A list of the Manufacturer’s recommended spare parts with the respective manufacturer's current price for each item. Include gaskets, packing, etc. on the list. Bearings shall be listed by the bearing manufacturer's numbers only.

7. Complete motor data, including, but not limited to: type of enclosure design, rated horsepower, rated voltage, FLA, Starting Current, LRA, LR KVA, NEMA Code Letter, rpm, input power in kw at nameplate rating, starting calculations, cable size, efficiency at 50%, 75% & 100% load, and power factor at 50%, 75% & 100% load.

C. Test Reports:

1. Certified motor test data.

2. Tabulated data for the drive motors including rated HP, full load RPM, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and KW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply without affecting their design life for bearings or windings.

3. A schedule of the date of shop testing and delivery of the equipment to the job site.

4. Description of pump factory test procedures and equipment.

5. All completed functional and performance testing reports.

D. Operating and Maintenance Manuals:

1. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

1.3 QUALITY ASSURANCE

A. The pumps furnished shall be in accordance with the Hydraulic Institute Standards and shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

B. The pump manufacturer shall have an authorized warranty center within a 100-mile radius of the job site, fully staffed with factory trained mechanics.

C. Vibration, when measured in the direction of maximum amplitude at the top motor bearing, shall not exceed the allowable values as presented in the Hydraulic Institute Standards at any speed within the specified operating speed range.

1.4 DELIVERY, STORAGE, AND HANDLING

A. All spare parts shall be properly protected for long periods of storage and packed in containers which are clearly identified with indelible markings as to the contents.

B. All equipment and parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication until final delivery to the job site.

C. All equipment and parts must be properly protected against any damage during a prolonged period at the site.

1.5 SPARE PARTS

A. One (1) set of all special tools required for normal maintenance shall be provided by the Manufacturer.

B. The Manufacturer shall furnish a complete set of recommended spare parts necessary for the first five (5) years of operation for each pumping station.

1.6 WARRANTY

A. All equipment supplied under this section shall be warranted for a period of one (1) year by the Contractor and the pump Manufacturer. Warranty period shall commence on the date of Owner acceptance.

B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.

C. The Manufacturer's warranty period shall run concurrently with the Contractor's warranty period.

PART 2 - PRODUCTS

2.1 SUMBERSIBLE WASTEWATER PUMPS

A. Manufacturers:

1. Pumps shall be Model NT 3356/749 3~670, 215 HP, 460 Volt, 3-phase, FM, FLS, premium efficient motor with closed loop cooling, N-Series hard iron impeller, dry pit configuration with 16" suction elbow as manufactured by FLYGT.

B. Pump Design Configuration:

1. Pumps shall be capable of operating in a continuous non-submerged operating condition in a vertical (NT) position in a dry pit installation and permanently connected to inlet and outlet pipes, Pump shall be of submersible

construction and will continue to operate satisfactorily should only the dry pit be subjected to flooding.

2. The pump(s) shall be supplied with a mating 14-inch discharge connection and be capable of 10 MGD (each) at a total dynamic head of 92-feet. An additional point on the same curve shall be 5MGD at a total dynamic head of 86-feet. Shut off head shall be a minimum of 168-feet. The motor shall be an integral part of the pump unit. The motor shall be 215 HP, 6 pole, connected for operation on a 480 volt, 3 phase, 60 hertz electrical supply service. Each pump motor shall be equipped with 25 feet of power and control cable sized in accordance with NEC and CSA standards. Pumps for dry-pit installation shall be supplied with a steel mounting frame.

C. Pump Construction:

1. Casting: Shall be of gray cast iron, EN-GJL-250 (ASTM A-48, Class 35B) with smooth surfaces devoid of porosity or other irregularities. All exposed fasteners shall be of stainless steel, 1.4401 (AISI 316). All metal surfaces coming into contact with the pumped media (other than the stainless-steel components) shall be protected by a factory applied spray coating of a polyester resin paint finish on the exterior of the pump.

2. Sealing: Sealing design shall incorporate metal-to-metal contact between machined surfaces. Pump/Motor unit mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile (Buna-N) O-rings. Joint sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific bolt torque limit. Rectangular cross sectioned rubber, paper or synthetic gaskets that require specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

3. Impeller: The impeller shall be of Hard-Iron(ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

4. Pump Volute: The pump volute shall be single-piece grey cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The discharge flange design shall permit attachment to standard ANSI and DIN flanges/appurtenances.

5. Pump Volute/Suction Cover: The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron® (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

D. Pump Motor:

1. The Premium Efficiency motor shall meet efficiency standards in accordance with IEC 60034-30:2008, level IE3 and NEMA Premium. Motor rating tests shall be conducted in accordance with IEC 60034-2-1 requirements and shall be certified accurate and correct by a third-party certifying agency. IE3 and NEMA Premium efficiency levels are equivalent, however the NEMA Premium standard is intended to cover dry installed motors only, not integrated submersible motors.

2. The motor shall be of the squirrel-cage induction design, NEMA type B. The copper stator windings shall be insulated with moisture resistant, Class H insulation rated for 180°C (356°F). The stator shall be insulated by the current-UV-dip impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The use of multiple step dip and bake-type stator insulation process is not acceptable. Insulation material, rated for 180°C (356°F). The stator shall be heat shrink fitted into the stator housing. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing is unacceptable. The rotor bars and short circuit rings shall be made of cast aluminum.

3. The motor shall be designed for submersible pump usage and continuous duty. The maximum continuous temperature of the pumped liquid shall be 40°C (104°F) and 80°C temperature rise. The motor shall be capable of handling up to 15 evenly spaced starts per hour without overheating. The combined service factor (as defined by the NEMA MG1 standard) shall be 1.5. The motor shall have a voltage tolerance of +/- 10% from nominal, and a phase to phase voltage imbalance tolerance of 1%. The motor shall have a NEMA Class A temperature rise, providing cool operation under all operating conditions. The motor shall be FM approved for use in NEC Class I, Division I, Groups C & D hazardous locations. The surface temperature rating shall be T3C. The motor shall meet the requirements of NEMA MG1 Part 30 and 31 for operation on PWM type Variable Frequency Drives. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

E. Cooling System:

1. Each pump/motor unit shall be provided with an integral, self-supplying cooling system. The motor water jacket shall encircle the stator housing and shall be of cast iron, ASTM A-48, Class 35B. The water jacket shall thus provide heat dissipation for the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air. After passing through a classifying labyrinth, the impeller back vanes shall provide the necessary circulation of the cooling liquid, a portion of the filtered pump media, through the cooling system. Two cooling liquid supply pipes, one discharging low and one discharging high within the jacket, shall supply the cooling liquid to the jacket. An air evacuation tube shall be provided to facilitate air removal from within the jacket. Any piping internal to the cooling system shall be shielded from the cooling media flow allowing for unobstructed circular flow within the jacket about the stator housing. Two cooling liquid return ports shall be provided. The internals to the cooling system shall be non-clogging by virtue of their dimensions. Drilled and threaded provisions for external cooling and, seal flushing or air relief are to be provided. The cooling jacket shall be equipped with two flanged, gasketed and bolted inspection ports of not less than 4"- diameter located 180 degrees apart. The cooling system shall provide for continuous submerged or completely non-submerged pump operation in liquid or in air having a temperature of up to 104°F (40°C), in accordance with NEMA standards. Restrictions limiting the ambient or liquid temperatures at levels less than 104°F (40°C) are not acceptable. to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40°C) in accordance with NEMA standards. Operational restrictions that limit the ambient or pumped liquid temperatures at levels less than 40°C are not acceptable.

2. Cooling systems that use a toxic cooling liquid shall not be acceptable. The use of external heat exchangers, fans, or the supply of supplemental cooling liquid shall not be required.

F. Pumps shall include the following Monitoring Sensors. See instrumentation drawings for termination at LCP panel:

1. Lower bearing PT-100 Temperature Sensor

2. Stator Winding PT-100 1st Winding Temperature Sensor

3. Junction Box Leakage Sensor

4. Stator Housing Leakage Sensor

5. 3-Axis Vibration Sensor

6. Pump Memory Module

G. Thermal Protection:

1. Each phase of the motor shall contain a normally closed bi-metallic temperature monitor switch imbedded in the motor windings. Thermal

switches shall be embedded in the stator end coils to monitor the temperature of each phase winding. One PT-100 type temperature sensor shall be installed in the stator winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. A mechanical float switch (FLS) shall be mounted in the junction chamber to signal if there is water intrusion. A pump memory module shall be provided and mounted in the junction chamber to record pump run time, number of starts as well as contain the motor unit performance and manufacturing data and service history. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

H. Vibration Monitoring Protection:

1. Reinstall existing vibration sensors. Install mounting puck permanently to pump. Submit location and means for attachment with the pump submittal.

I. Mechanical Seals/Protection System:

1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The lower seal shall be independent of the impeller hub. The seals shall operate in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. The Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counterclockwise direction of rotation without damage or loss of seal. For special applications, other seal face materials shall be available.

2. The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to affect sealing shall be used.

3. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with

positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate continuously while non submerged without damage while pumping under load.

4. Seal lubricant shall be nonhazardous.

J. Seal Failure Early Warning System:

1. Should both seals fail and allow fluid to enter the stator housing, a port shall be provided to direct that fluid immediately to the stator float switch to shut down the pump and activate an alarm. Any intrusion of fluid shall not come into contact with the lower bearings.

K. Shaft:

1. The pump shaft and motor shaft shall be a solid continuous shaft. The pump shaft shall be an extension of the motor shaft. Couplings shall not be acceptable. Pump shaft shall be an integral, one-piece unit adequately designed to meet the maximum torque required at any normal start-up condition or operating point in the system. The shaft shall have a full shutoff head design safety factor of 1.7, and the maximum shaft deflection shall not exceed .05 mm (.002 inch) at the lower seal during normal pump operation. Each shaft shall be of stainless steel, AISI 431 and shall have a polished finish with accurately machined shoulders to accommodate bearings, seals and impeller. Carbon steel, chrome plated, or multi-piece welded shafts shall not be considered adequate or equal.

L. Bearings:

1. The pump shaft shall rotate on at least three grease-lubricated bearings. The lower bearings shall consist of at least one roller bearing for radial forces and one or two angular contact ball bearings for axial thrust. The minimum L_{10} bearing life shall be 100,000 hours at any point along the usable portion of the pump curve at maximum product speed. The lower bearing housing shall include an independent thermal sensor to monitor the bearing temperature. If a high temperature occurs, the sensor shall activate an alarm and shut the pump down.

M. Insulated Bearings

1. The upper support bearing, provided for radial forces, shall be a single roller bearing and shall have an insulated outer ring to provide protection against potential bearing damage from electrically induced currents that can be created especially when the motor is used with a VFD. The outer ring shall have a plasma-spray technique or oxide-ceramic coating that provides an insulating barrier between the bearing face and the bearing housing of the pump.

2. Each pump shaft shall rotate on high quality, permanently lubricated, greased bearings. Bearings shall be of sufficient size and properly spaced to transfer all radial and axial loads to the pump housing and minimize shaft deflection. The bearings shall be manufactured by a major internationally known manufacturer of high-quality bearings and shall be stamped with the manufacturer's name and size designation on the race. Generic or unbranded bearings from other than major bearing manufacturers shall not be considered acceptable.

N. Power Cable:

1. The power cables shall be sized according to NEC and ICEA standards and shall be of sufficient length to reach the junction box without requiring splices. The outer jacket of the cable shall be of chlorinated polyethylene (CPE) rubber and be oil, water, and UV resistant, capable of continuous submerged operation underwater without loss of watertight integrity to a depth of 65 feet or greater.

O. Cable Entry/Junction Chamber:

1. The cable entry design shall not require a specific torque to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by stainless steel washers. The assembly shall provide ease of changing the cable when necessary, using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

2. A cable cap incorporating a strain relief and bend radius limiter shall mount to the cable entry boss, compressing the grommet ID to the cable while the grommet OD seals against the bore of the cable entry. The junction chamber shall be isolated and sealed from the motor by means of sealing glands. Electrical connections between the power cables and motor leads shall be made via a compression or post type terminal board, allowing for easy disconnection and maintenance. An access port shall be located in the center of the motor lid to allow easy access to the electrical connections without the need to remove the entire motor lid.

P. Accessories:

1. Base Assembly (dry-pit installation): The pump shall be secured to a steel support stand attached to cast concrete support pillars (concrete support pillars supplied by others) of suitable strength to support the weight of the pump and resist any expected torsion, bending, or vibration forces. The pump shall be suitable for either vertical or horizontal dry-pit installation without requiring any internal modifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that inlet and discharge piping connections are size, location, and elevation as indicated on drawing.

B. Verify layout and orientation of pumps, accessories, and pipe supports.

C. Verify pipe supports are prepared and level.

3.2 INSTALLATION

A. Installation shall be in strict accordance with the Manufacturer's instructions and recommendations in the locations shown on the Drawings. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer’s recommendations.

B. The Contractor shall submit a certificate from the Manufacturer stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.3 TESTING

A. In the event that the equipment does not meet the Final Acceptance Test, the Contractor shall, at its own expense, make such changes and adjustments in the equipment which it deems necessary and shall conduct further tests until full satisfaction is indicated by the Engineer and written certification is received thereof.

B. After all pumps have been completely installed, and working under the direction of the Contractor, conduct in the presence of the Engineer such tests as are necessary to indicate that pumps conform to the Specifications.

C. The Final Acceptance Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:

1. That all units have been properly installed and are in correct alignment.

2. That the units operate without overheating or overloading any parts and without objectionable vibration.

3. That there are no mechanical defects in any of the parts.

4. That the pumps can deliver the specified pressure and quantity of raw, unscreened sewage.

5. That the pump sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper level alarm functions.

D. Motors:

1. The Contractor shall check all motors for correct clearance and alignment and for correct lubrication in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections if necessary.

3.4 MANUFACTURER'S SERVICES:

A. A manufacturer's trained specialist, experienced in the installation of the specified pump, and with at least five (5) years of field experience shall be present at the job site for two (2) days to provide the following services:

1. Installation Inspection: Prior to system start-up, the Manufacturer shall inspect the installation of the equipment including instrumentation and control power wiring to verify installation is satisfactory for operation.

2. Start-Up Services: The Manufacturer shall provide a technical representative to the project site to observe the start-up and commissioning of the equipment, adjust the equipment, and troubleshoot problems with the equipment as needed.

3. Operator Training: The Manufacturer shall provide a minimum of 4 hours of training at the project site to review the Operations and Maintenance (O&M) Manuals for the project with the operations personnel.

a. O&M Manuals used for the training must have prior approval by the Engineer through the submittal process to use in the training.

b. Manufacturer to provide Owner signatures of operators attending the training certifying they have completed the training provided for the project.

4. If there are difficulties in operation of the equipment due to the Manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

3.5 DEMONSTRATION

A. Execution and Closeout Requirements: Requirements for demonstration and training in accordance with MASS 2015.

END OF SECTION

SECTION IV

SUBMITTAL LIST AND STANDARD FORMS

Submittal List

Submittal Transmittal

Certificate of Compliance

ADEC Certificate of Construction – Wastewater Only

Design Clarification & Verification Request

Deviation Request

Substitution Request

Subcontractor & Supplier List

Municipality of Anchorage

Anchorage Water and Wastewater Utility

2024 SEWER IMPROVEMENTS

PUMP STATION 2 REHABILITATION

Submittal List

Job #: WW.00079 Contractor: _____

Submittal No.	Description	Submittal Schedule
10.03.2	Bid Submittals	Prior to the time of opening specified in the Invitation to Bid and the exact date and time of receipt of Bids shall be recorded.
10.04.9	Waste disposal on private property	Prior to construction.
10.04.13	Traffic Control Plan (TCP)	Within ten (10) days of NTP, or five (5) days before commencement of work, whichever is earlier.
10.04.15	Storm Water Pollution Prevention Plan (SWPPP)	No less than twelve (12) days prior to the beginning of excavation or within 10 days of NTP, whichever comes first.
10.04.19	Record Documents	Within thirty (30) days after Substantial Completion or prior to Final Acceptance of the project, whichever is earlier.
10.04.22	24-Hour Emergency Contact Number*	Prior to commencement of work * Found in Construction Specifications
10.05.3	Construction Progress Schedule	Within ten (10) days of the effective Notice to Proceed, and prior to the commencement of Work.
10.05.3	Critical Path Method (CPM) Schedule	No later than twenty-one (21) days from the effective date of the Notice to Proceed and at least monthly thereafter.
10.05.4	Unusual Working Hours	At least forty-eight (48) hours advance notice.

Municipality of Anchorage

Anchorage Water and Wastewater Utility

2024 SEWER IMPROVEMENTS

PUMP STATION 2 REHABILITATION

Submittal List

10.05.5	Shop Drawings	Within reason and in such sequence as to cause no delay in the Work or in the work of the Owner or any other contractor.
10.05.6	Product Data	Within reason and in such sequence as to cause no delay in the Work or in the work of the Owner or any other contractor.
10.05.7	Materials Substitutions	Within ten (10) calendar days of the effective date of the Notice-to-Proceed (or such time as may be approved in writing by the Engineer.)
10.05.10	Subcontractor List	Within ten (10) days after the effective date of the Notice-To-Proceed, and prior to the commencement of the Work.
10.05.18	Changed Conditions	No later than two (2) working days, and before such conditions are disturbed.
10.05.20	Change Order Proposal	Prior to payment of changed Work
10.05.21	Claims for Additional Compensation	Initial Notification - Immediately.
10.05.26	Pre-Final Inspection Notification	After completion of Work After code compliance inspections
10.05.29	Termination of Work for Owners Convenience	Immediately after receiving a Notice of Termination.
10.05.34	Work Plan	Prior to beginning construction.
10.06.9	Insurance	Prior to execution of the Contract.
10.07.4	Change Order Proposal/ Negotiated Changes	Prior to payment of the changed Work.
10.07.5	Application for Partial Payment	

Municipality of Anchorage

Anchorage Water and Wastewater Utility

2024 SEWER IMPROVEMENTS

PUMP STATION 2 REHABILITATION

Submittal List

10.07.7	Final Payment	Upon completion of the Work and issuance of a certificate of completion by the Engineer, and prior to acceptance of the work.
20.02.3.A	Hazardous Material Control Plan (HMCP), Spill Prevention, Control, and Countermeasure Plan (SPCC)	7 days prior to commencement of excavation work
20.02.3.B	Storm Water Pollution Prevention Plans (SWPPP)	No less than ten (10) days prior to the beginning of excavation or within 10 days of NTP, whichever comes first.
20.12.3	Construction Dewatering Plan	No less than seven (7) days prior to the beginning of dewatering activities.
20.30.3	Excavation, Shoring, and Temporary Material Storage Plan	Submitted three (3) days prior to the beginning of work involving shoring. Submitted ten (10) days prior to construction or within 10 days of NTP, whichever comes first.
30.01.7	Ready-Mixed Concrete	Prior to unloading the concrete mix at the construction site.
40.06.2.A	Asphalt Concrete Pavement	Prior to paving.
40.07.3.E	Job-Mix	Fifteen (15) days prior to paving.
40.07.5	Paving Plan	Minimum of five (5) days prior to commencement of paving.
65.02.14	As-built Surveys and Record Drawings	Upon completion of construction activity.
70.12.1	Traffic Control Plan (TCP)	Prior to commencement of project.
75.04.2	Seed Certification	Ten (10) days prior to application

NOTE: The above list of submittals is not all-inclusive. In addition to the above, the Contractor is required to comply with all submittal requirements as required or identified in the plans, Special Provisions, MASS, or as directed by the Engineer. (See Division 10, Section 10.04, Article 4.3.)

SUBMITTAL TRANSMITTAL

PROJECT: _____ SUBMITTAL NO.: _____

CONTRACTOR: _____ CONTRACT NO.: _____

ORIGINATOR: _____ SPEC. SECTION: _____

DATE SUBMITTED: _____ DRAWING NO.: _____ SHEET _____ OF _____

TO: ANCHORAGE WATER & WASTEWATER UTILITY
Engineering Division
3000 Arctic Boulevard

ATTN: _____

ITEM: _____

SUPPLIER/CONTRACTOR:

☐ Original Submittal ☐ 3rd

☐ 2nd ☐ 4th

		REVIEW ACTION						
ID. NO.	DETAILED DESCRIPTION (Provide Itemized List of Contents of this Submittal)	COPIES SENT	NO EXCEPTION TAKEN A	MAKE CORRECTIONS AS NOTED B	AMEND AND RESUBMIT C	REJECTED RESUBMIT D	COPIES RETURNED	NOTES ATTACHED

Complete either (a) or (b), following:

☐ (a) We have verified that the material or equipment contained in this submittal meets all the requirements specified or shown (no exceptions).

☐ (b) We have verified that the material or equipment contained in this submittal meets all the requirements specified or shown, except for the following deviations (list deviations, attach a separate sheet if necessary).

Corrections or comments made relative to submittals during this review do not relieve the Contractor from compliance with the requirements of the drawings and specifications. This submittal is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of other trades, and performing his work in a safe and satisfactory manner.

CONTRACTOR: _____ ENGINEER: _____
(Signature) (Signature)

ROUTING	RECEIVED BY NAME / COMPANY	DATE RECEIVED	DATE FORWARDED	COMMENTS
Project Manager				
Designer				
Project Manager				
Contractor				

AWWU SUBMITTAL REVIEW ACTION

PROJECT _____ SUBMITTAL NO. _____

CONTRACTOR _____ CONTRACT NO. _____

ORIGINATOR _____ SPEC. SECTION _____

DATE SUBMITTED _____ DRAWING NO. _____ SHEET _____ OF _____

A-NO EXCEPTION TAKEN
B-MAKE CORRECTIONS AS NOTED
C-AMEND AND RESUBMIT
D-REJECTED RESUBMIT

REVIEW ACTION	ID. NO.	COMMENT:

ENGINEER: _____ DATE: _____

CERTIFICATE OF COMPLIANCE

Project Name: _____ Contract No. C-_____

I (WE) CERTIFY THAT ALL WORK HAS BEEN PERFORMED AND MATERIALS SUPPLIED IN ACCORDANCE WITH THE PLANS, SPECIFICATIONS AND CONTRACT DOCUMENTS FOR THE ABOVE WORK, AND THAT:

A. Not less that the prevailing rates of wages as ascertained by the governing body of the contracting agency has been paid to laborers, workmen, and mechanics employed on this work;

B. There have been no unauthorized substitutions of subcontractors; nor have any subcontracts been entered into without the names of the subcontractors having been submitted to the Engineer prior to the start of such subcontracted work;

C. No subcontract was assigned or transferred or performed by any subcontractor other than the original subcontractor, without prior notice having been submitted to the Engineer together with the names of all subcontractors;

D. All claims for material and labor and other services performed in connection with these specifications have been paid;

E. All monies due the State Industrial Accident Fund, the State Unemployment Compensation Trust Fund, the State Tax Commission, hospital associations and/or other have been paid.

_____
(Company Name)

_____ _____
(Contractor's Signature) (Date)

STATE OF ALASKA)
)ss.
THIRD JUDICIAL DISTRICT)

The foregoing instrument was acknowledged before me this _____ day of _____, 20 ___, by _____ to be the _____ of the company.

_____
Notary Public
My commission expires: _____

DESIGN CLARIFICATION/VERIFICATION REQUEST (DC/VR)

PROJECT _____ **DC/VR NO.** _____

CONTRACTOR _____ **CONTRACT NO.** _____

ORIGINATOR _____ **SPEC. SECTION** _____

DATE SUBMITTED _____ **DRAWING NO.** _____ **SHEET** _____ **OF** _____

DESCRIPTION OF DC/VR

RESPONSE REQUESTED BY (Date) _____

RESPONSE TO DC/VR

RESPONSE BY (Name/Company) _____

ROUTING	RECEIVED BY NAME / COMPANY	DATE RECEIVED	DATE FORWARDED	COMMENTS
Project Manager				
Designer				
Project Manager				
Contractor				

DIRECTION

☐ **Proceed per Engineers Response. No change in contract price or time is recognized.**

☐ **Do not proceed until** _____

☐ _____

DEVIATION REQUEST (DR)

PROJECT _____ **DR NO.** _____

CONTRACTOR _____ **CONTRACT NO.** _____

ORIGINATOR _____ **SPEC. SECTION** _____

DATE SUBMITTED _____ **DRAWING NO.** _____ **SHEET** _____ **OF** _____

DESCRIPTION OF DR

A. Original Contract Requirements:

B. Reason for Deviation Request:

C. Proposed Deviation:

D. Any Changes in Contract Time or Cost ☐ **YES** ☐ **NO**

CONTRACTOR SIGNATURE -
Date_____

RESPONSE
REQUIRED BY (Date)_____

RESPONSE TO DR

RESPONSE BY (Name/Company)_____

ROUTING	RECEIVED BY NAME / COMPANY	DATE RECEIVED	DATE FORWARDED	COMMENTS
Project Manager				
Designer				
Project Manager				
Contractor				

DIRECTION

☐ **Approved**

☐ **Approved as Noted** **BY** _____
(Signature)

☐ **Disapproved**

SUBSTITUTION REQUEST (SR)

PROJECT _____ **SR NO.** _____

CONTRACTOR _____ **CONTRACT NO.** _____

ORIGINATOR _____ **SPEC. SECTION** _____

DATE SUBMITTED _____ **DRAWING NO.** _____ **SHEET** _____ **OF** _____

SPECIFIED ITEM:

SECTION	PAGE	PARAGRAPH	DESCRIPTION

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: _____

Attached data includes product description, specifications, drawings, photographs and performance and test adequate for evaluation of the request. Applicable portions of the data are clearly identified.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings and will not require any change in any of the Contract Documents.
2. The undersigned will pay for changes to the design, including engineering design, detailing, and construction costs caused by the requested substitution which is estimated to be $_____.
3. The proposed substitution will have no adverse affect on other contractors, the construction schedule (specifically the date of substantial completion), or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.
5. The incorporation or use of the substitution in connection with the work is not subject to payment of any license fee or royalty.

The undersigned further states that the function, appearance, and quality of the Proposed Substitution are equivalent or superior to the Specified Item.

Submitted by CONTRACTOR	**Reviewed by ENGINEER**
Signature: _____	☐ **Accepted**
Firm: _____	☐ **Accepted as Noted**
_____	☐ **Not Accepted**
Date: _____	☐ **Received too Late**
Telephone: _____	
	By: _____
Attachments:	**Title:** _____
_____	**Date:** _____
_____	**Remarks:** _____

ANCHORAGE WATER AND WASTEWATER UTILITY

Subcontractor/Supplier List

Project Name:

Project Number:

List all suppliers, subcontractors, their mailing addresses and a summary of the extent and character of the work to be performed by each:

Supplier/Subcontractor	Address	Extent/Character of Work

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

SECTION V

CONTRACT AND BID DOCUMENTS

Contract

Bid Bond

Performance & Payment Bond

Certificate of Insurance

Bidder's Checklist

Contractor Questionnaire

C O N T R A C T

Invitation to Bid No. **2024C_____**

Contract No. **C-2024_____**

NAME AND ADDRESS OF CONTRACTOR:

_____

_____

_____

Check appropriate box:

☒ **Incorporated in the State of**

MUNICIPALITY OF ANCHORAGE, acting through _____ (hereinafter the Owner).

Contract for _____

BID SCHEDULES	**ITEMS**	**PLAN SHEET FILE NUMBERS**	**AMOUNT**
			$ _____

Total Amount : $ _____

THIS CONTRACT, entered into by the MUNICIPALITY OF ANCHORAGE, ALASKA, acting through the Owner named above, and the individual, partnership, or corporation named above, hereinafter called the Contractor, WITNESSETH that the parties hereto do mutually agree as follows:

Statement of Work: The Contractor shall furnish all labor, equipment and materials and perform the Work above described, for the amount stated, in strict accordance with the Contract Documents.

CONTRACT DOCUMENTS

I. This CONTRACT consisting of 4 pages.

II. The Bid Proposal Section ___ consisting of ____ pages numbered as ____, **as contained in ITB 2024C_____.**

III. The Contract Performance and Payment Bond **_____.**

IV. The Contractor's Certificate of Insurance Dated **_____.**

V. Municipality of Anchorage Standard Specifications dated 2015 (MASS) Incorporated by Reference, **as contained in ITB 2024C_____.**

VI. Specifications consisting of the following:

Supplemental Provisions Section _____ consisting of _____ pages, with attachments Exhibit A through F, **as contained in ITB 2024C_____.**

VII. Equal Opportunity Special Provisions and Forms Section _____ consisting of _____ pages, **as contained in ITB 2024C_____.**

VIII. Disadvantaged/Women-Owned Business Enterprise (DBE/WBE) Specification Section _____ consisting of _____ pages, **as contained in ITB 2024C_____.**

IX. The Laborers' and Mechanics' Minimum Rates of Pay dated September 1, 2015 Section _____ consisting of _____ pages, **as contained in ITB 2024C_____.**

X. Submittal List Section _____ consisting of _____ page, **as contained in ITB 2024C_____.**

XI. The Drawings consisting of _____ sheets numbered _____, **as contained in ITB 2024C_____.**

IN WITNESS WHEREOF, the parties hereto have executed this Contract as of the Contract Date entered below.

MUNICIPALITY OF ANCHORAGE, ALASKA

BY _____
Signature

Purchasing Officer or designee
Title

_____
Date of Signature and Contract Date:

VENDOR _____

BY _____
Signature

_____
Printed Name

_____
Title

_____
Date of Signature

CONTRACT AND PERFORMANCE AND PAYMENT BOND SIGNATURE INSTRUCTIONS

1. The full name and business of the Contractor shall be inserted on Page 1 of the Contract and on the Performance and Payment Bond, hereinafter the Bond.
2. Two copies of the Contract and the Bond shall be manually signed by the Contractor. If the Contractor is a partnership or joint venture, all partners or joint ventures shall sign the Contract and the Bond except that one partner or one joint venturer may sign for the partnership or joint venture when all other partners or joint venturers have executed a Power-of-Attorney authorizing one partner or joint venturer to sign. The Power-of-Attorney shall accompany the executed contract and the Bond.
3. If the Contractor is a corporation, the President of the corporation shall execute the Contract and the Bond unless a Power-of-Attorney or corporate resolution shall accompany the executed Contract and Bond.
4. The Bond shall be returned to the Purchasing Division undated. The Contract Date shall be inserted on the Contract when the Municipality signs the Contract and the Bond shall be dated the same as the Contract Date.

BID BOND

KNOW ALL MEN BY THESE PRESENTS, That we, _____ as Principal, and _____ a corporation organized under the laws of the _____ and authorized to transact surety business in the State of Alaska, of _____ _____ as Surety, are held and firmly bound unto the MUNICIPALITY OF ANCHORAGE, as Obligee, in the full and just sum of _____ _____ ($_____) Dollars, lawful money of the UNITED STATES, for the payment of which sum, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by the presents.

WHEREAS, the said Principle is herewith submitting its proposal for _____ _____.

The condition of this obligation is such that if the aforesaid Principal will, within the time required enter into a formal contract and give a good and sufficient bond to secure the performance of the terms and conditions of the contract, then this Obligation to be void; otherwise the Principal and Surety will pay unto to the Obligee the amount stated above.

Signed, sealed, and delivered _____, 20_____.

WITNESS AS TO PRINCIPAL:

_____ _____
Contractor Name

_____
Contractor Signature

_____
(AFFIX CORPORATE SEAL) Corporate Surety

_____

_____
Surety Business Address

BY: _____
(Attorney-In-Fact)

(AFFIX SURETY SEAL)

CONTRACT PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, That we_____
_____ of _____
as Principal, and _____
a corporation organized under the laws of the _____
_____ and authorized to transact surety business in the State of Alaska, of _____
as Surety, are held and firmly bound unto the MUNICIPALITY OF ANCHORAGE, as Obligee, in the full and just sum of _____
($_____) Dollars, lawful money of the UNITED STATES, for the payment which, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION IS SUCH, that whereas the principal has entered into a certain contract dated the _____ date of _____ 20_____, with the Obligee for the construction of _____
_____
which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW THEREFORE, if the Principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions, and agreements of said contract, and shall promptly make payments to all persons supplying labor and material in the prosecution of the work provided for in said contract, during the original term of said contract and any extensions or modifications thereof that may be granted by the Municipality, with or without notice to the Surety, then this obligation to be void; otherwise to remain in full force and effect.

This obligation is made for the use of said Obligee and also for use and benefit of all persons who may perform any work or labor or furnish any material in the execution of said Contract and may be sued on thereby in the name of said Obligee.

The said Surety, for the value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to the work to be performed thereunder or the specifications accompanying the same, shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the work or to the specifications.

Whenever Principal shall be, and declared by Obligee to be in default under the Contract the Obligee having performed Obligee's obligations thereunder, the Surety may promptly remedy the default or shall promptly:

1. Complete the Contract in accordance with its terms and conditions, or
2. Obtain a bid or bids for submission to Obligee for completing the Contract in accordance with its terms and conditions and upon determination by Surety of the lowest responsible bidder, or, if the Obligee elects, upon determination by Obligee and the Surety jointly of the lowest responsible bidder, arrange for a contract between such bidder and Obligee and make available as Work progresses (even though there should be a default or a succession of defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price but not exceeding, including other costs and damages for which the Surety may be liable hereunder the amount set forth in the first paragraph hereof. The term "balance of the contract price" as used in this paragraph, shall mean the total amount payable by Obligee to Principal under the Contract and any amendments thereto, less the amount properly paid by Obligee to Principal.

IN TESTIMONY WHEREOF, the parties hereunto have caused the execution hereof in _____ _____ original counterparts as of the _____ day of _____, 20_____.

WITNESS AS TO PRINCIPAL:

_____ _____
Principal Name

_____
Principal Signature

_____
Corporate Surety

(AFFIX CORPORATE SEAL)

_____

_____
Surety Business Address

BY: _____
(Attorney-In-Fact)

(AFFIX SURETY SEAL)

INSURANCE

By submitting a bid, the bidder agrees, if they are the successful bidder, to obtain and maintain the insurance required by this section. The bidder also agrees to provide the Municipality a copy of their Certificate of Liability Insurance prior to signing the contract and prior to commencement of any work under this contract.

GENERAL: The Contractor will not allow any subcontractor to commence work until the subcontractor has obtained insurance as listed in this section. The contractor and each subcontractor shall maintain this insurance throughout the life of this contract, including any maintenance and/or guarantee/warranty period. The contractor shall obtain separate insurance certificates for each contract.

ADDITIONAL INSURED: The Municipality of Anchorage shall be listed as an additional insured on all General and Auto Liability policies required by this contract. All policies shall contain a waiver of subrogation against the Municipality, except Professional Liability. All policies shall remain in effect during the life of the contract. The Contractors insurance certificate shall also indicate the Municipality of Anchorage as a certificate holder of the policy.

WORKERS COMPENSATION: The Contractor shall purchase and maintain during the life of this contract, workers compensation insurance for all employees who will work on this project and, if any work is sublet, the Contractor shall require the subcontractor similarly to provide such insurance. Employers' Liability with a minimum limit of $500,000 shall be maintained and Workers Compensation with minimum limits as required by Alaska State Workers Compensation Statutes. The policy shall contain a waiver of subrogation against the Municipality.

NOTICE TO "OUT-OF-STATE" CONTRACTORS WORKING IN ALASKA: The Contractor shall provide evidence of Workers Compensation insurance, either State of Alaska Workers Compensation coverage or an endorsement to the Contractor's home state Workers Compensation policy, evidencing coverage for "other states" including Alaska, prior to execution of a contract or, if approved, before commencement of contract performance in Alaska.

GENERAL LIABILITY: The Contractor shall purchase and maintain, in force, during the life of this contract such general liability insurance as shall protect the Owner and the Contractor against losses which may result from claims for damages for bodily injury, including accidental death, as well as from claims for property damages which may arise from any operations under this contract whether such operations be those of the Contractor, a subcontractor or anyone directly or indirectly employed by either of them.

Commercial General Liability	**Minimum Limits**
Products/Completed Operations	$2,000,000
Personal & Advertising Injury	$1,000,000
Each Occurrence	$1,000,000
General Aggregate	$2,000,000
Medical Payments	$5,000
Commercial Auto Liability	**Minimum Limits**
Combined single limit (Bodily Injury and Property Damage)	$1,000,000
Including all owned, hired, and non-owned	
Workers Compensation and Employers Liability	**Minimum Limits**
Per Alaska statute	$500,000
Errors and Omissions	**Minimum Limits**
Professional Liability (Not required unless limits appear in space provided)	
Umbrella Liability	**Minimum Limits**
(Not required unless limits appear in space provided)	
$ _____ S.I.R.	

Each insurance policy required by this section shall require the insurer to give advance notice to the MOA/Contract Administrator prior to the cancellation of the policy. IF the insurer does not notify the MOA upon policy cancellation, it shall be the Contractor's responsibility to notify the MOA of such cancellation.

COMPLIANCE WITH LAWS

The Contractor shall observe and abide by all applicable laws, regulations, ordinances and other rules of the State of Alaska and/or any political subdivisions thereof, or any other duly constituted public authority wherein work is done or services performed, and further agrees to indemnify and save the Municipality of Anchorage harmless from any and all liability or penalty which may be imposed or asserted by reason of the Contractor's failure or alleged failure to observe and abide thereby.

(Remainder of Page Initially left Blank)

ACORD®

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) shall be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:	
	PHONE (A/C, No, Ext):	FAX (A/C,
	E-MAIL ADDRESS:	

INSURED	INSURER(S) AFFORDING COVERAGE	NAIC #
	INSURER A :	
	INSURER B :	
	INSURER C :	
	INSURER D :	
	INSURER E :	
	INSURER F :	

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY						EACH OCCURRENCE	$
	☐ COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence)	$
	☐ ☐ CLAIMS-MADE ☐ OCCUR						MED EXP (Any one person)	$
	☐						PERSONAL & ADV INJURY	$
	☐						GENERAL AGGREGATE	$
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG	$
	☐ POLICY ☐ PRO - ☐ LOC							$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$
	☐ ANY AUTO						BODILY INJURY (Per person)	$
	☐ ALL OWNED AUTOS ☐ SCHEDULED AUTOS						BODILY INJURY (Per accident)	$
	☐ HIRED AUTOS ☐ NON-OWNED AUTOS						PROPERTY DAMAGE (Per accident)	$
								$
	☐ **UMBRELLA LIAB** ☐ OCCUR						EACH OCCURRENCE	$
	☐ **EXCESS LIAB** ☐ CLAIMS-						AGGREGATE	$
	☐ DED ☐ RETENTION $							$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y / N						☐ WC STATU-TORY LIMITS ☐ OTH-ER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE ☐ N / A						E.L. EACH ACCIDENT	$
	OFFICER/MEMBER EXCLUDED? **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - EA	$
							E.L. DISEASE - POLICY LIMIT	$

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

1. The Municipality of Anchorage is an additional insured on Auto and General Liability policies. All policies, including workers compensation, contain a WAIVER OF SUBROGATION against the Municipality, except Professional Liability, .
2. CANCELLATION: "Should any of the above described policies be cancelled before the expiration date thereof, notice will be delivered in accordance with the Policy Provisions."

CERTIFICATE HOLDER	CANCELLATION
	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	Authorized Representative

BIDDER'S CHECKLIST

INSTRUCTION TO BIDDER

I. GENERAL:

Bidders are advised that notwithstanding any instructions or implications elsewhere in this Invitation to Bid only the documents shown and detailed on this sheet need be submitted with and made part of their bid. Other documents may be required to be submitted after bid time, but prior to award. Bidders are hereby advised that failure to submit the documents shown and detailed on this sheet shall be justification for rendering the bid nonresponsive. Evaluation of bids for responsiveness shall be accomplished in accordance with Anchorage Municipal Code, Title 7.

II. REQUIRED DOCUMENTS FOR BID

NOTE: "Only the following listed items as marked with an "X" are required to be completely filled out and submitted with the bid."

X Bid Proposal consisting of three (3) pages numbered BP-1 of 3 through BP-3 of BP 3. Bid Proposal Page **BP-2 of 5 must** be manually signed.

X Erasures or other changes made to the Bid Proposal Sheet must be initialed by the person signing the bid.

X Bid Bond, certified check, cashier's check, money order or cash shall be submitted with the bid in the amount indicated.

X All Addenda issued shall be acknowledged in the space provided on the Bid Proposal sheet or by manually signing the Addenda sheet and submitting it prior to the bid opening in accordance with Anchorage Municipal Code 7.20.020C.

X Subcontractor Information (See Section V).

X USEPA Certification of Nonsegregated Facilities (See Section V).

X USEPA Certification Regarding Debarment, Suspension, and Other Responsibility Matters (See Section V).

X ADEC DBE Compliance Statement (See Section IX, Appendix B).

X DBE Subcontractor Performance Form (AWWU FORM 6100-3), **FOR EACH PROPOSED DBE SUBCONTRACTOR.** If no DBE subcontractors are proposed, the form must still be signed by the bidder (See Section IX, Appendix C).

X In accordance with AO No. 2019-130 (S), Anchorage Municipal Code 7.20.030 and 7.20.070, Contractor Questionnaire consisting of three (3) Pages, Prime Contractor Form Filled out by Prime Contractor **and** all known subcontractors. **Please review AO NO. 2019-130 (S), AMC 7.20.030 and 7.20.070, and the attached Contractor Questionnaire before submitting a bid.**

Municipality of Anchorage
Contractor Questionnaire

Contractors/Vendors wishing to qualify for award of a bid or proposal offered by the Municipality of Anchorage shall submit this completed form and any supplemental information requested by this form within five days following a request by the Purchasing Officer.

This form is to be filled out by the prime, and subcontractors that perform work "on-site". On-site is defined as the physical place or places where the building or work called for in the contract will remain, and any other site where a significant portion of the building or work is constructed, provided that such site is established specifically for the performance of the contract or project.

Contractor/Vendor Name: _____

Owner(s) of Company (if sole proprietorship or partnership):_____

_____

List all Alaska construction contractor's registration numbers, registration types and expiration dates of the Alaska business licenses held by your company in the past three years:

_____

_____

Has your company changed names, business license number, or contractor registration number in the past three years?

☐ Yes ☐ No

If "Yes," explain on a separate signed page, including the reason for the change.

Has any owner, partner or (for corporations) officer of your company operated any business offering similar services outlined in the bid or proposal under any other name in the past three years?

☐ Yes ☐ No

If "Yes," explain on a separate signed page, including the reason for the change.

Certifications & Disclosures

For these questions & certifications, "company" includes any entity that shares or has shared majority ownership or control with your company. "Determination of violation" includes any citations, orders or recommendations issued to or against the company.

Debarment

1. In the last three years has your company been debarred from bidding on, or being awarded, a state or federal project?

   ☐ Yes ☐ No

Occupational Safety & Health

Note: Only willful violations of state or federal occupational safety and health laws will result in disqualification; disclosure of other violations does not lead to automatic disqualification.

2. In the last three years has your company been determined to have committed a **willful violation** of state or federal occupational safety and health law? For purposes of this question, a state or federal occupational safety and health law includes laws enforced by the Occupational Safety and Health Administration (OSHA), Alaska Occupational Safety and Health (AKOSH), or another state's occupational safety and health agency.

   ☐ Yes ☐ No

3. In the last three years, has the federal Occupational Safety and Health Administration (OSHA), Alaska Occupational Safety and Health (AKOSH), or another state's occupational safety and health agency, made a determination of violation against your company?

   Note: If you have filed an appeal of a citation and the appropriate appeals board has not yet ruled on your appeal, you need not include information about it.

   ☐ Yes ☐ No

   If "Yes," attach a separate signed page describing each citation.

Wage & Hour

Note: Only willful violations of state or federal wage and hour laws will result in disqualification; disclosure of other violations does not lead to automatic disqualification.

4. In the last three years has your company been determined to have committed a **willful violation** of state or federal wage and hour law?

   ☐ Yes ☐ No

5. In the last three years has there been a determination of violation of wage and hour laws against your company? Wage and hour violations include failure to pay minimum wages, overtime, or prevailing wages.

   ☐ Yes ☐ No

   If "Yes," attach a separate signed page describing each violation, identifying the claim by claimant, date, and status/outcome.

Unemployment Insurance & Workers' Compensation

6. In the last three years has there been a determination of violation of unemployment insurance or workers' compensation requirements against your company?

   ☐ Yes ☐ No

   If "Yes," attach a separate signed page describing each violation, identifying the claim by claimant, date, and status/outcome.

Licensing & Registration

7. If a license or certificate of fitness is required to perform any services provided by your company, has there been a determination of violation of any certificate of fitness requirements against your company in the last three years?

☐ Yes ☐ No

If "Yes," attach a separate signed page describing each violation, identifying the claim by claimant, date, and status/outcome.

Subcontracting

8. I certify that all independent subcontractors engaged by my company meet the definition of an independent contractor under Alaska Statute 23.30.230.

☐ Yes ☐ No

9. I understand that my company is responsible for ensuring that each subcontractor my company uses on the project completes this form and associated documentation. I will submit any disclosures required by Anchorage Municipal Code.

☐ I understand

10. I understand that my company is responsible for providing this form and any associated documentation for each subcontractor hired after award within 30 days of hire, and that the subcontractor may not begin work on the project until such information is provided.

☐ I understand

11. I understand that my company is responsible for ensuring that if any event, such as a violation or loss of coverage, causes the information submitted by the subcontractor to change, the subcontractor shall submit updated certifications or disclosures within 30 days of occurrence to the department contract administrator.

☐ I understand

I declare under penalty of perjury that the foregoing is true and correct.

Dated: _____ _____
(Signature)

_____
(Printed name and title)

Right to Appeal: Anchorage Municipal Code provides that any person adversely affected in connection with the award of a municipal contract, including the Municipality's determination on responsibility, may request that the mayor or assembly refer the matter to the bidding review board.

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

SECTION VI

BID PROPOSAL

BID PROPOSAL
(CERTIFICATION)

TO: MUNICIPALITY OF ANCHORAGE _____, 2024
PURCHASING DEPARTMENT
632 W. 6TH AVENUE, SUITE 520
ANCHORAGE, ALASKA 99501

SUBJECT: Invitation to Bid No. 2024C029

PROJECT TITLE: Pump Station 2 Rehabilitation

Pursuant to and in compliance with subject Invitation to Bid, and other bid documents relating thereto, the bidder hereby proposes to furnish all labor and materials and to perform all work for the construction of the above referenced project in strict accordance with the bid documents at the prices established in the Bid Proposal, page **BP- 1 of 3 through BP- 3 of 3** submitted herewith.

The bidder agrees, if awarded the contract, to commence and complete the work within the time specified in the bid documents.

LUMP SUM, BASIC BID: $ _____

The bidder acknowledges receipt of the following addenda:

Addenda No._____ Addenda No. _____
Addenda No._____ Addenda No. _____
Addenda No._____ Addenda No. _____

Enclosed is a Bid Bond in the amount of _____.
(Dollar Amount or Percentage of Bid)

Type of Business Organization
The bidder, by checking the applicable box, represents that it operates as ( ) a corporation incorporated under the laws of the State of _____, ( ) an individual, ( ) an LLC, ( ) a partnership, ( ) a nonprofit organization, or ( ) a joint venture. If a partnership or joint venture, identify all parties on a separate page.

Is this project Federally Funded?
Yes ☐
No ☒

_____
Company Name

SUBJECT: Invitation to Bid No. 2024C029
PROJECT TITLE: **PUMP STATION 2 REHABILITATION**

Date

Alaska Contractor's License Number

Company Name (Printed)

Employer's Tax Identification Number

Authorized Representative Signature

Printed Name & Title

Company **Mailing** Address

Company Phone Number

City, State, Zip Code

Company Fax Number

Company Email Address

Company **Physical** Address
(if different from mailing address)

City, State, Zip Code

BID PROPOSAL

ITEM NO.	MASS NO.	WORK DESCRIPTION			ESTIMATED QUANTITY	UNIT BID PRICE	TOTAL BID PRICE
1	10.07.5	Utility Work Allowance (Electric Service)	per	CS	1	$150,000.00	$150,000.00
2	50.05	Sewer Flow Control	per	LS	1		
3	50.09	Pump Station 2 Rehabilitation	per	LS	1		

Total Bid Amount $ _____

_____ _____

Contractor Date

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

SECTION VII

OTHER UTILITY REQUIREMENTS

CEA Facility Requirements

ENSTAR Safety Requirements

CHUGACH
POWERING ALASKA'S FUTURE

December 7, 2020

ELECTRICAL FACILITY CLEARANCE REQUIREMENTS

Enclosed please find a copy of Chugach Electric Association, Inc.'s (Chugach) Electrical Facility Clearance Requirements policy. Periodically, copies of this policy are mailed out to various companies and agencies whose activities may bring their personnel in close proximity to Chugach's electrical facilities. Chugach distributes copies of this policy in an effort to help minimize and identify potential hazards for construction personnel and the general public. In addition, Chugach is concerned with preventing damage to its electrical facilities and any disruption of electrical service to its customers. Please note that the Electrical Facility Clearance Requirements publication may be found on Chugach's website at: www.chugachelectric.com. Click on the "Member Services" tab and go to "Regulations & Requirements", click on "Electrical Facility Clearance Requirements" (December 7, 2020).

For your additional information, Alaska State Statute ("AS 42.30.400 " Excavator's Notice of Proposed Excavation") has been included as an attachment.

Please thoroughly read and understand the entire document. It could save your life or the life of your employees and the public. We request that particular attention be paid to the following provisions:

(Paragraph B. 2.) "Under no circumstances will Chugach allow any of its underground cable(s) to remain energized after it has been exposed, unless it is protected by supplementary mechanical protection approved by Chugach or unless a *qualified person* is on site at all times".

(Paragraph H. 7.) "Chugach defines a *qualified person* as a journeyman lineman who holds a current Certificate of Fitness in the Journeyman Lineman category issued by the State of Alaska". These two provisions clearly emphasize Chugach's position relating to the exposure and approach to energized facilities.

Chugach strongly recommends that prior coordination takes place between Chugach and the construction entity or contractor , either during the design phase of a project or prior to the start of construction, to help eliminate or minimize conflicts. If you have questions, please contact the Line Operations Division at (907) 762-7679 and your call will be directed to the appropriate department for assistance.

Sincerely,

James Mullican

James Mullican
Senior Manager Line Operations

Enclosures

cc: MOA Development Services; State of Alaska OSHA Inspector; SOA Electrical Inspector; AGC, Cook Inlet Housing, GCI, ACS, Enstar, AWWU, Anchorage Home Builders Association

Chugach Electric Association, Inc.
5601 Electron Drive, P.O. Box 196300, Anchorage, Alaska 99519-6300 • (907) 563-7494 • Fax (907) 562-0027 • (800) 478-7494
www.chugachelectric.com

CHUGACH ELECTRIC ASSOCIATION, INC.

CLEARANCE REQUIREMENTS FOR CONSTRUCTION OR MAINTENANCE NEAR ELECTRICAL FACILITIES

Chugach's concern for the safety of non-qualified personnel working adjacent to its electrical facilities, its concern for the public in general, and its requirement that only *qualified personnel* under the employ of *qualified electrical contractors* handle electrical facilities such as conductors, cables, poles, transformers, padmounted equipment, etc., is based upon the following considerations:

- The potential for serious injury and resulting liability is extremely high when dealing with all electric utility voltage levels up to 230,000 volts on overhead and underground lines.

- Certain types of equipment, particularly cable, can easily be damaged by improper handling. For example, when cable is hit or improperly suspended (common during excavation adjacent to cables), the scraped, cut, or stressed insulation will almost always result in premature cable failure. The highest risk to unqualified personnel is a cable failure while the cable is being handled during excavation or construction. Undetected cable damage may result in a subsequent cable failure with consumer outages for periods of up to a week's duration during winter conditions.

- The inherent stability of overhead pole lines or padmounted equipment is jeopardized with improper excavation and backfill, often resulting in hazardous voltage exposure to the public and contractors and leads to consumer power outages.

The above concerns can be minimized by the use of properly trained, licensed, and certified electrical outside linework personnel. The National Electrical Safety Code (NESC), the United States Occupational Safety and Health Administration (OSHA) and the Alaska State OSHA support this position as well as the clearances addressed herein.

The NESC, defines *"qualified"* as *"Having been trained in and having demonstrated adequate knowledge of the installation, construction, or operation of lines and equipment and the hazards involved, including identification of and exposure to electric supply and communication lines and equipment in or near the workplace."* Only qualified persons are permitted to handle or work on or adjacent to energized electrical facilities. This includes not only overhead pole lines but also padmounted

and underground facilities. Within the NESC, two rules specifically address the need for qualified persons to perform work on or near energized facilities:

> Rule 420B1 states, *"Employees whose duties require working on or in the vicinity of energized equipment or lines shall perform only those tasks for which they are trained, equipped, authorized, and so directed. Inexperienced employees shall: (a) work under the direction of an experienced and qualified person at the site; and (b) perform only directed tasks."*
>
> Rule 420B4 states, *"Employees who do not normally work on or in the vicinity of electric supply lines and equipment but whose work brings them into these areas for certain tasks shall proceed with this work only when authorized by a qualified person."*

OSHA 29CFR 1910.269 contains the training and documentation requirements for a qualified person.

OSHA 29CFR 1926.1408 addresses equipment operations near electrical lines. If any part of the equipment, when operated up to the equipment's maximum working radius, could get closer than twenty (20) feet to a power line, then the operator must notify the utility, verify line voltage, and implement one of the safety options in OSHA 29CFR 1926.1408.

At no time may equipment violate minimum required clearance to an energized power line: ten (10) feet for lines up to 50 kilovolts (kV), or ten (10) feet plus 0.4 inches per one (1) kV over 50 kV. Minimum clearances are provided below for common Chugach system voltages.

CHUGACH SYSTEM VOLTAGES	
Normal Voltage (Phase-to-Phase)	**Minimum Clearance Required At All Times**
Operations Near High-Voltage Overhead Power Lines to 50 kV	10 Feet
Over 50 kV to 200 kV	15 Feet
Over 200 kV to 350 kV	20 Feet

Specifically, 29CFR1926.1408 (b)(4)(ii) requires a "Safety Observer" during equipment operations if the equipment is operating where it is difficult for the operator to maintain twenty (20) feet of clearance to the overhead power line(s) by visual means. Alaska Statutes (AS) Sections 18.60.670 through Section 18.60.695 govern placement and operation of equipment near electrical lines or conductors. 29CFR1926, Subpart P addresses the specific requirements involved with trenching operations. These include prior notice to utility companies, prior location of utility facilities, and proper supports once the facilities are exposed. Furthermore, 29CFR Sections 1910.180; 1910.333; 1926.416; and 1926.651 regulate activities relative to job site electrical facilities.

In summary, Chugach's concern for the safety of all personnel affected by work adjacent to its energized facilities has led to the development of the attached policy.

ELECTRICAL FACILITY CLEARANCE REQUIREMENTS

The following requirements have been developed to help provide a safer work site to those personnel working adjacent to Chugach's electrical facilities and to protect Chugach facilities that are in proximity to the area of work being done by State or Municipal entities and private construction and maintenance projects.

A. NOTIFICATION

It is recommended that Chugach be informed of construction/maintenance activities as early as possible in the design process and be included in timely plan reviews. Any work that needs to be performed on Chugach facilities must have prior Chugach approval.

1. Overhead Facilities

Any work in the proximity of overhead power lines shall be preceded by a call to Chugach at (907) 762-7679 , at least 48 hours in advance, as notification of the planned work and compliance with OSHA 29CFR1926 (1408), and AS 18.60.670. If equipment, tools, machinery, or material must work in proximity closer than the minimum clearances outlined in OSHA 29CFR1926 (1408), and AS 18.60.670, the requirements of AS 18.60.680 shall be implemented before work can proceed. All necessary arrangements with Chugach by the requesting party for compliance with AS 18.60.680 shall be arranged in advance of the project start date.

2. Underground Facilities

Alaska Statutes 42.30.400 through 42.30.490, Anchorage Municipal Code, 24.40 and 26.90, and 29CFR1926, Subpart P place requirements on contractors who will be excavating around or adjacent to underground utilities. Advance notification requirements, underground facility locates, and the responsibilities for protection of utility facilities by contractors are specified in these regulations. All requests for locates of Chugach's underground facilities are to be made through the Alaska Digline at 811. Prior to excavation, Chugach's Line Operations Department shall be contacted at (907) 762-7679 a minimum of two (2) business days in advance of construction.

Locate surface markings are only reasonably accurate to +/- two (2) feet. Chugach and State law require hand-digging within two (2) feet of locate marks. In some cases, hand-digging may be required within three (3) or four (4) feet of the markings, depending on the facility involved and field

conditions at the project site. Maintaining locate marks is the responsibility of the party requesting the locate. Chugach may charge for re-locating and re-marking facilities that were previously marked.

B. UNDERGROUND CABLE EXCAVATION

1. Any excavation which is within a three (3) foot radius of a cable and parallels a cable for a distance greater than twenty (20) feet in length (see Section H.1 below) may require relocation of that cable. Excavations shorter in length and/or closer may also require relocation. At a minimum, cables that will require exposure must be exposed by *hand-digging* only, by a *qualified person* under the employ of a *qualified electrical contractor* (see Section H). See Drawing No. F-062388 attached.

2. Any excavation, such as a trench which crosses cable and/or conduit, shall be limited to twenty (20) feet in width and have provisions for the exposed cable/conduit to be supported every two (2) feet on a Chugach approved support system, to prevent cable damage. The cable support work and excavation within the three (3) foot radius (see Section H-1) shall be performed by a *qualified* person under the employ of a *qualified electrical contractor.*

   NOTE: When excavation must occur within the limits specified in B.1, and B.2, above, reasonable efforts will be made by Chugach to de-energize the cable if system conditions and personnel requirements allow. Even if the cable has been de-energized, a "Cable Watch" by a qualified person under the employ of a qualified contractor is still required. To request the de-energization of the cable, contact the Chugach Line Operations Department at (907) 762-7679 and your call will be directed to the appropriate department for assistance. Requests must be made three (3) business days in advance of the outage date requested. For emergencies, contact Chugach's Dispatch Center at (907) 762-4660.

   Under no circumstances will Chugach allow any of its underground cable(s) to remain energized after it has been exposed, unless it is protected by supplementary mechanical protection approved by Chugach or unless a qualified person is on site at all times.

3. Should any cable be exposed by non-qualified personnel, Chugach must be immediately contacted for field investigation before work may resume in the immediate area of such exposed cable.

Chugach recognizes that reasonable continuation of work may be required around energized underground cables after Chugach inspects the site. When this occurs, it is the responsibility of the construction contractor working at the site to arrange for qualified personnel as well as payment of the costs of said personnel and/or equipment. Chugach will neither arrange for, nor provide qualified personnel to satisfy this requirement unless Chugach determines this course of action is in its best interest, on a case-by-case basis. Where Chugach is otherwise forced to subsequently take steps to ensure the safety of the site, Chugach will advise the construction contractor that Chugach will pass these costs to the construction contractor.

4. In all cases, a final minimum burial depth of forty (40) to sixty (60) inches for primary-voltage (above 1000 volts) circuits and thirty (30) inches for secondary voltage (480V or below) circuits shall be maintained. If, however, existing Federal, State, or Municipal permit conditions require depths in excess of forty (40) inches, then the cable/conduit shall be buried at the depth required in the permit. The depth is measured from the top of the cable/conduit to final grade at the shallowest depth. Burial shall be in compliance with Chugach Construction Standard SUR 2-3, 5 or 6 (supplied upon request).

5. Projects that will increase final grade to sixty (60) inches or greater above Chugach direct buried cable shall require relocation at the customer's expense. Where cables are in conduit, review and written approval by Chugach is required for proposed grade changes resulting in a burial depth of sixty (60) inches or greater.

6. Projects which propose to modify the grade over Chugach's underground cables/circuits at voltages above 25kV require review and written approval by Chugach in all cases.

7. Excavations near underground cable/circuits energized above 25kV will require the following:

   a) Excavation Adjacent to Cables/Circuits Energized Above 24kV
   Chugach will require its Locate Contractor to notify excavators when a locate request includes the locating of cables are energized above 25kV.

   When excavation is planned that will come within ten (10) feet, expose, parallel, or undermine sections of Chugach's underground cables energized above 25kV, special precaution and safety

consideration must be taken. These distribution and sub-transmission cables operate at voltages of 34.5kV (34,000 volts) and transmission cables operate above 34.5kV up to 230kV (230,000 volts), provide power to tens of thousands of Chugach customers and require extraordinary protection. The following guidelines shall apply:

Chugach Line Operations Department shall be contacted at (907) 762-7679 in advance of the planned excavation a minimum of five (5) business days prior to beginning excavation. Chugach requires that a *qualified person* be on site at all times during excavation activity that comes within ten (10) feet of any circuit cable energized above 24kV. The contractor shall arrange and pay for a *qualified person* from Chugach or, with approval, from one of Chugach's approved and *qualified contractors*. Excavations closer than ten (10) feet shall require exposure of the cables (vac-truck, pot-holing or other approved means) at the intersecting point or at intervals of not less than every twenty-five (25) feet for parallel excavations by *qualified personnel* to determine the exact location of the cable prior to machine excavation.

Excavations within ten (10) feet of cables energized above 25kV can expose unqualified workers to potentially high fault currents and extremely unsafe conditions. Prior planning by the construction contractor with coordination and approval from Chugach for any excavation projects within ten (10) feet of circuits or cables energized above 25kV is mandatory.

Chugach may require a special locate utilizing Ground Penetrating Radar to locate critical facilities. "Pothole" locates utilizing vacuum excavation in conjunction with an air-knife tool may be used, with Chugach approval.

C. STRUCTURE EXCAVATION

1. Equipment Pads or Vaults

Temporary excavation is allowed with a maximum slope of 1:1 beginning three (3) feet from the exterior edge of a concrete pad or vault. The final grade shall consist of a level area radiating out a minimum of four (4) feet, measured from the exterior edge of the pad or vault, and a maximum slope of 2:1 beginning from that four (4) foot distance from the exterior edge of the pad or vault. For both temporary and final grade situations, a level

area extending ten (10) feet out from the edge of the concrete pad in front of equipment doors or access panels is necessary. Refer to Drawing No. F-062388 attached.

If the slope cannot be maintained at the grades specified above, additional protection such as barriers or piling is required. All shoring and excavation (closer than the above limits) shall be done by a qualified person(s) under the employ of a qualified electrical contractor.

2. Concrete-Encased Duct

Excavation wider than five (5) feet under a concrete-encased duct requires a method designed and certified by an Alaska-registered civil engineer and approved by Chugach. Installation of the temporary shoring or bracing shall be done under the supervision of a qualified person under the employ of a qualified electrical contractor.

D. POLE/GUY ANCHOR EXCAVATION

Excavation beginning no closer than a three (3) foot radius from a pole or guy anchor in stable soil conditions or a ten (10) foot radius from a pole or guy anchor in organic/unstable soil conditions is allowed, provided the slope from that point does not exceed 1:1. Refer to Drawing No. F-062388 attached.

Excavation closer than the limits defined above or within a ten (10) foot radius of more than one consecutive pole where excavation will be open while more than one pole is affected, may require shoring of each pole. Chugach review and approval of a shoring plan is required for all excavations where more than one pole is subject to an open excavation. Pole shoring shall be approved by Chugach for the specific excavation. All work for installing poles must be performed within OSHA guidelines. Shoring by other methods requires prior approval by Chugach on a case-by-case basis. Streetlight poles may be temporarily removed, subject to a written agreement with Chugach, prior to excavation.

Any excavation that may expose the pole butt requires a structural analysis of the pole shoring method. The analysis shall be performed by an Alaska-licensed professional engineer familiar with electrical transmission and distribution design standards in use by Chugach. Chugach also reserves the right, at contractor expense, to have a structural engineer examine any excavation deeper than the pole butt within a fifteen (15) foot radius of the pole.

All shoring and excavation (closer than the above limits) shall be done by a qualified person under the employ of a qualified electrical contractor.

E. RELOCATION REQUIRED

Where protection of the cable and structures cannot be maintained, as required in Sections A, B, and C, relocation of those facilities will be required prior to the intended work and at the contracting agency's expense.

F. BACKFILL

Replacement backfill for electrical facilities must be in accordance with Chugach specifications and performed by a qualified person under the employ of a qualified electrical contractor.

A damaged underground facility may not be reburied until it is repaired or relocated to the satisfaction of Chugach.

G. INSPECTION AND APPROVAL

All work on or in the immediate vicinity of Chugach facilities, such as backfilling, temporary support, shoring, and relocations are subject to prior approval and inspection by Chugach. On large projects where inspection time is substantial, all costs for inspection shall be the responsibility of the agency or entity contracting for the work. Reimbursement to Chugach shall be in accordance with Chugach's tariff, Section 8.

For any questions or approvals involving these requirements contact Chugach Line Operations at (907) 762-7679 and your call will be directed to the appropriate department for assistance.

H. MISCELLANEOUS

1. Depending on the soil type, depth and length of the excavation, type of Chugach facility involved, and the certainty of the cable locate markings, excavations can be approved within a two (2) foot radius of cable on a case-by-case basis.

2. Stable soil conditions are defined as all dry and non-organic. Soil conditions shall be evaluated and approved on a case-by-case basis by Chugach. The evaluation will be done using 29CFR1926, Subpart P, "*Excavations*" as a guide.

3. Excavation, except as noted, shall be defined as mechanically performed by a backhoe, trencher, scraper, grader, auger, or other equipment.

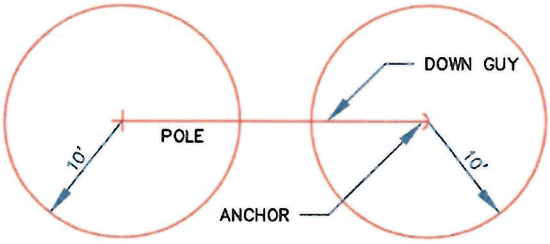
4. Cables are defined as insulated conductors whether buried directly or in conduit. The guidelines for cables also include 600-Volt pedestals and other small electrical apparatus associated with cables but not included under pads or vaults.

5. Spare conduit is not included in these provisions except to the extent of providing temporary support when exposed and inspected by Chugach prior to the placement of proper backfill.

6. Chugach defines a *qualified electrical contractor* as a contractor registered in the State of Alaska who has an Electrical Administrator's License in the Outside Linework category; or who has an employee with an Electrical Administrator's License in the same category registered with the contractor.

7. Chugach defines a *qualified person* as a journeyman lineman who holds a current Certificate of Fitness in the Journeyman Lineman category issued by the State of Alaska.

8. Chugach defines *hand-digging* as the removal of soil with hand tools, an air-knife tool (compressed air jet), or a vacuum truck.

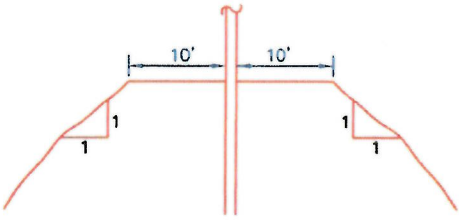


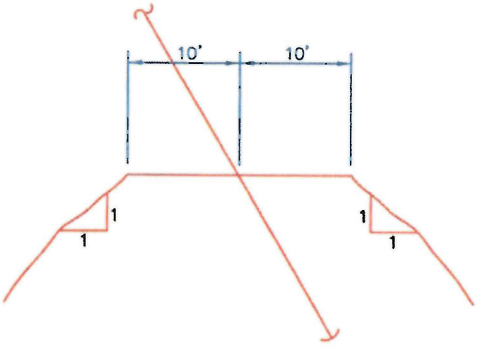
PLAN

(RADIUS OF UNDISTURBED SOIL)

NOTE:

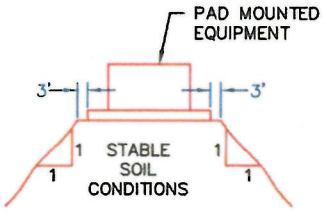
FOR VERY UNSTABLE SOIL CONTACT CHUGACH ELECTRIC.





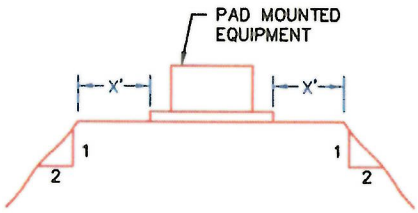
PROFILE

POLES/GUYS



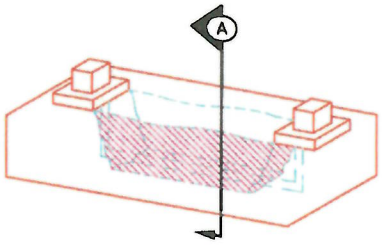
DURING CONSTRUCTION

SUPPLEMENTAL SUPPORT REQUIRED FOR EXCAVATIONS WITHIN 5' OF PADMOUNTED EQUIPMENT LOCATED ON UNSTABLE SOIL CONTACT CHUGACH ELECTRIC

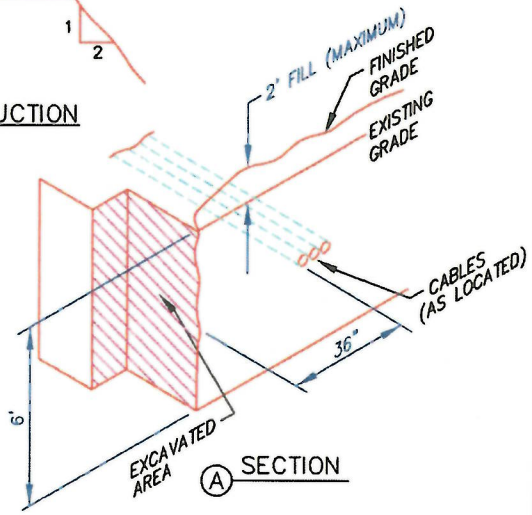


AFTER CONSTRUCTION

X': 10' ON DOOR/ACCESS SIDES. 4' ON OTHER SIDES.



PARALLEL EXCAVATION



STRUCTURES/CABLES

REV. NO.: 3 DATE: 1/28/98

Standards Engineer: _____

Mgr., Dist. Engineering: _____

Mgr., Const. & Maint.: _____

Dir., T&D Services Div.: _____

Chugach Electric Association, Inc.

EXCAVATION LIMITS

DEFINITION OF LIMITS REQUIRING NO ADDITIONAL STRUCTURAL SUPPORT

DRAWING NUMBER F-062388

SHEET 1 OF 1

Sec. 42.30.450. Waiver of requirements by written agreement.

An operator and an excavator may, by written agreement, waive the requirements of AS 42.30.400 - 42.30.490 that the excavator notify the operator of planned excavations and that the operator locate underground facilities. The agreement must identify the geographic areas to which the waiver applies and the time period for which the waiver is valid.

Sec. 42.30.460. Underground facility owner.

If the operator of an underground facility is not the owner of the facility and if the operator cannot be identified or has been identified but cannot be reached in a reasonable amount of time, the excavator may give the notice required by AS 42.30.400 - 42.30.490 to the owner of the underground facility and the owner shall assume the duties and responsibilities of the operator under AS 42.30.400 - 42.30.490.

Sec. 42.30.490. Definitions.

(1) "damage" means

(A) the substantial weakening of structural or lateral support of an underground facility;

(B) penetration, impairment, or destruction of any underground protective coating, housing, or other protective device; and

(C) the partial or complete severance of an underground facility to the extent that the project owner or facility operator determines that repairs are required;

(2) "emergency" means

(A) a condition that constitutes a clear and present danger to life, health, or property; or

(B) an unplanned service interruption;

(3) "excavation" means

(A) an activity in which earth, rock, or other material on or below the ground is moved or otherwise displaced by any means;

(B) road maintenance that changes the original road grade;

(C) demolition or movement of earth by equipment, tools, or explosive device except tilling of the soil less than 12 inches in depth for agricultural purposes;

(4) "excavator" means a person who conducts excavation in the state;

(5) "inaccessible" means impossible or unreasonably difficult to reach due to conditions beyond the control of the underground facility operator;

(6) "notification center" or "center" means a service through which a person is able to call one number to notify member operators of underground facilities that an excavation is proposed and to request the operators to mark facilities located inside of the proposed excavation area;

(7) "operator" means a person who supplies a service for commercial or public use by means of an underground facility;

(8) "person" means any individual, public or private corporation, political subdivision, government agency, municipality, industry, partnership, copartnership, association, firm, trust, estate, or any other entity whatsoever;

(9) "remote" means not accessible by road;

(10) "underground facility" means a pipe, sewer, conduit, cable, valve, line, or wire, including attachments and those parts of poles or anchors that are below ground, for use in connection with the storage or conveyance of water, sewage, telecommunications, cable television, electricity, petroleum, petroleum products, hazardous liquids, or flammable, toxic, or corrosive gas;

(11) "unstaffed" means not normally staffed with employees;

(12) "working day" means a day on which an underground facility operator is open for regular business.

ALASKA STATUTES

TITLE 42

PUBLIC UTILITIES & CARRIERS

Sec. 42.30.400. Excavator's notice of proposed excavation.

(a) Before beginning an excavation, an excavator shall give notice of the proposed excavation to each underground facility operator who has an underground facility in the area of the proposed excavation and request the operator to field mark the location of its underground facility. The excavator shall notify an underground facility operator who subscribes to a notification center by giving notice to the center. The excavator shall notify an underground facility operator listed in the applicable telephone directory who is not a subscriber to a notification center by giving notice directly to the operator.

(b) Except in the case of an emergency locate request or a request to locate in a remote, unstaffed, or inaccessible location, the excavator shall notify an underground facility operator who may have a facility in the area of a proposed excavation at least two but not more than 15 working days before the date scheduled for beginning the excavation. In the case of a request to locate in a remote or unstaffed location, the excavator shall notify the operator at least 10 but not more than 20 working days before the scheduled date for beginning excavation.

(c) In an emergency, the excavator shall immediately notify each underground facility operator in the area of the emergency and of the need for the excavation and request prompt location of underground facilities.

Sec. 42.30.410. Operator's response to request to locate; immunity related to unmarked or inaccurately marked facilities.

(a) An underground facility operator shall accept requests to locate underground facilities during the operator's regular business hours. An operator who receives a request to locate shall maintain for at least one year an accurate record of the request and responses to the request.

(b) When an underground facility operator receives a request to locate, it shall notify the excavator of the location of the underground facilities that the operator is able to field mark with reasonable accuracy and field mark those facilities. If the operator owns, uses, or operates an underground facility that is identified as being in the area of the proposed excavation but that the operator cannot field mark with reasonable accuracy, the operator shall provide the excavator with the best information available to the operator about its location and shall provide on-site assistance until the facility is located or until the excavator no longer needs assistance in locating that facility.

(c) The field marks for an underground facility buried 10 feet deep or less must be located within 24 horizontal inches of the outside dimensions of the facility. For a facility buried deeper than 10 feet, the operator shall locate the field marks within 30 horizontal inches of the outside dimensions of the facility. The operator shall use stakes, paint, or other clearly identifiable material to show the field location of the underground facility. The marker used to designate the approximate location of an underground facility must follow the current color code standard used by the American Public Works Association.

(d) Except for an underground facility in a remote, unstaffed, or inaccessible location, an underground facility operator shall respond to a request to locate promptly. A response is considered to be prompt if it is made within two working days after the operator receives the request or at a later time so long as the response occurs before the beginning of the excavation. For an underground facility in an accessible remote or unstaffed location, the operator shall respond within 10 working days after the operator receives the request or at a later time so long as the response occurs before the beginning of excavation.

(e) After an operator has field marked an underground facility, the excavator is responsible for maintaining the markings.

(f) An excavator may not begin to excavate until each underground facility has been field marked.

(g) When an operator has field marked an underground facility once at the request of an excavator, the operator has the right to receive compensation from the excavator for costs incurred in responding to subsequent requests to locate the same underground facility during the same excavation project if the excavator failed to maintain the original marking.

(h) If an excavator discovers an underground facility that was not field marked or was inaccurately field marked, the excavator shall immediately stop excavating in the vicinity of the facility and shall notify the operator of the discovery. The excavator may notify the operator by means of a notification center. The operator shall treat the notification as a request to locate in an emergency and shall respond accordingly. An excavator may not be held liable for inadvertent damage caused to an unmarked or an inaccurately marked underground facility.

(i) Unless the request to locate is made in response to an emergency, an underground facility operator has the right to receive compensation for costs incurred in responding to a request to locate that gives the operator less notice than the minimum notice required by this section. This subsection may not be interpreted to require the operator to respond to the request to locate within the time requested in the notice.

Sec. 42.30.420. Responsibility of construction project owners.

The owner of a construction project that will require excavation shall indicate in bid documents or contracts for construction the existence of underground facilities that the project owner knows are located inside of the proposed area of excavation. This requirement does not release the excavator from the excavator's responsibility under AS 42.30.400 - 42.30.490.

Sec. 42.30.430. Obligations concerning the conduct of excavations.

(a) An excavator shall use reasonable care to avoid damaging an underground facility. The excavator shall

(1) determine, without damage to the facility, the precise location of an underground facility whose location has been marked;

(2) plan the excavation to avoid damage to and minimize interference with an underground facility in or near the excavation area; and

(3) to the extent necessary to protect a facility from damage, provide support for an underground facility in and near the construction area during the excavation.

(b) An excavator who, in the course of excavation, contacts or damages an underground facility shall notify the operator. If the damage causes an emergency, the excavator shall also alert appropriate local public safety agencies and take reasonable steps to ensure public safety. A damaged underground facility may not be reburied until it is repaired or relocated to the satisfaction of the operator. The operator of an underground facility that was damaged during excavation shall arrange for repair or relocation of the facility as soon as practical.

Sec. 42.30.440. Penalties; injunctive relief.

(a) In addition to all other remedies provided by law, a person who violates a provision of AS 42.30.400 - 42.30.490 is subject to a civil penalty of not less than $50 nor more than $1,000 for each offense if the violation results in or significantly contributes to damage to an underground facility.

(b) If the court finds that an excavator is violating or threatening to violate a provision of AS 42.30.400 - 42.30.490 and the violation may result in damage to an underground facility, the court may grant injunctive relief to the underground facility operator.

Safety Requirements For Excavation Adjacent To Natural Gas Pipelines

ENSTAR Natural Gas Company / Alaska Pipeline Company

Safety

ENSTAR Natural Gas Company provides natural gas service through 3,200 miles of gas mains to over 133,000 customers in South Central Alaska. ENSTAR's gas pipeline system is designed, installed, and maintained with the highest regard for safety in compliance with applicable federal, state, and local government statutes and regulations. ENSTAR is regularly inspected to ensure that its operation meets industry standards.

The US Department of Transportation, Pipeline & Hazardous Materials Safety Administration (PHMSA) oversees minimum safety regulations for the transportation of natural gas by pipelines. The DOT safety regulations are currently published in Title 49, Part 190, 191, 192 & 199 of the Code of Federal Regulations (CFR).

As an operator of a natural gas system, ENSTAR is required by the DOT regulations to:

1. Deliver gas safely and reliably to customers.
2. Provide training and written instruction for employees.
3. Establish written procedures to minimize hazards resulting from gas pipeline emergencies.
4. Keep records of inspections and testing.
5. Test employees in safety-sensitive positions for prohibited drugs and alcohol.

Pipeline Reliability

Safety is and always will be unequivocally the number one priority for the natural gas industry. The industry spends billions of dollars each year to ensure the safety and reliability of the natural gas infrastructure. Natural gas utilities are subject not only to their own stringent internal controls, but also must meet rigorous federal and state oversight. Inspections are performed regularly by PHMSA regulators to ensure that compliance is being met.

Historically, excavation damage is the leading cause of most serious pipeline failures. Over 50% of the 312 damages to ENSTAR's pipelines last year were done by excavators that failed to obtain locates. Call before you dig, it's free and it's the law. Calling for locates is now as simple as dialing **811**. Dialing **811** anywhere in the United States connects you with the Locate Call Center for that area. In Alaska, dialing **811** connects you with Alaska Digline Inc. Alaska Digline Inc. will take your excavation information and notify all affected utilities. Utilities have two business days to mark their utilities after receiving your call.

Pressure Classification

Natural gas is a potentially dangerous, compressible gas. Gas pipelines with the highest pressure contain the highest stored potential energy and present the greatest risk. Caution is always warranted when working around natural gas facilities. **Extreme caution must be exercised whenever transmission pipelines are encountered. Contact ENSTAR Engineering Dept., (907) 264-3740 for specific instructions before working within 10 feet of any transmission pipeline.**

Pressure Classification	Pressure Rating Range	Pipeline Material
Transmission Pressure	Greater than 60 psig	Steel
Distribution Pressure	60 psig or less	Polyethylene, Steel, Copper

Recognizing ENSTAR's Pipelines

ENSTAR transmission pipelines are generally marked above ground with pipeline markers similar to the one shown. Transmission pipelines are located in the vicinity of the pipeline markers. Transmission pipelines are steel and range in size from 4" to 20" in diameter. They are typically coated with a protective coating. There is no single color but yellow and black are the predominant color while some are green or brown.

Typical ENSTAR Pipeline Marker

Distribution pipelines are steel, copper or polyethylene with locate wire. These pipelines range in size from ½" diameter to 12" in diameter. Gas "Mains" are typically found in street right-of-ways or utility easements and supply the natural gas to an entire street or subdivision. They are typically steel or polyethylene and range in size from 2" to 12" in diameter.

Natural gas "service lines" are connected to the gas main. Service lines generally serve a single building or small group of buildings on private property. Service lines are typically ½" to 1" in diameter. Service lines can be rigid steel, steel tubing, copper or polyethylene with locate wire. Gas mains and service lines are generally black or yellow in color.

Excavation Requirements for Natural Gas Pipelines

1 **Line Locating is a Free Service:** To request a locate, dial **811** the new Nationally recognized One-Call number and you will be connected to Alaska Digline Inc. Call at least two but not more than 15 working days before the date scheduled for beginning the excavation. Hand digging is advised when excavating within 2 feet of a marked facility. After ENSTAR has field marked with yellow paint, or flagged the location of an underground facility, the excavator is responsible for maintaining the markings. **Failure to call is a violation of state statutes and could result in fines well in excess of the cost of the damage.**

2 **Support for Steel Line Crossings:** If an excavation below a **steel gas** pipeline leaves the pipeline unsupported for a distance of more than 20 feet, the excavator must provide additional support for the pipeline. Support must be provided in a way as to not damage the pipe or its coating during construction, backfill placement, and compaction. Generally, a support spacing of 5 feet or less will provide the needed bracing. ENSTAR Engineering must approve all excavations crossing steel pipelines above 4-inch diameter. If support is required, ENSTAR engineering written approval is required prior to beginning construction. Call ENSTAR Engineering (907) 264-3740 for further information. Extra care must be taken when geotextile fabric and/or rigid insulation are used. In addition to continuous support under the pipeline, compacted fill material shall be placed between the geotextile fabric/rigid insulation and the pipeline. Care shall be taken to insure stability for the ENSTAR facility. Failure to properly protect ENSTAR's facilities could result in future damage if differential settlement occurs.

3 **Support for Polyethylene Line Crossings:** If an excavation is below a **polyethylene gas pipeline** the excavator must continuously support such pipeline during construction, backfill placement, and compaction. Geotextile fabric and/or rigid insulation shall be sufficiently separated from the polyethylene gas pipeline to prevent undue stress during the compaction/settlement process. (see item 8 clearance)

4 **Excavation Parallel to Pipeline:** When parallel excavations are expected to expose or undermine sections of pipeline, the excavator must notify ENSTAR engineering in advance. Care must be taken not to damage the pipeline, or to induce stresses due to differential settlement following construction**. Long parallel excavations exposing pipelines can be very dangerous if not properly performed and shall not be attempted without prior approval by ENSTAR.** Contact ENSTAR Engineering at 264-3740 for additional information.

5 **Blasting:** All blasting that is to be done within 500' of any Company Facility, shall be reviewed by an ENSTAR engineer, with the person performing the blasting and appropriate measures, (i.e. require minimum distance from facilities, minimize blasting charge intensity, etc.) shall be taken to protect the integrity of the Company's Facilities. A leak survey shall be performed after any blasting activity, which is within 500' of any Company Facility. The leak survey zone shall include all Company Facilities within 500' radius of the blasting.

6 **Trenchless Excavation (Vertical or Horizontal):** **Whenever a trenchless excavation (horizontal or vertical) is performed within 5 feet of a distribution pressure pipeline and 10 feet of a transmission pressure pipeline, the gas pipeline must be exposed to visually determine the exact location.** If the trenchless excavation is expected to cross the pipeline within the aforementioned distances, the pipeline in question shall be fully exposed to a minimum of 1 foot beneath the pipeline prior to the expected crossing to ensure that the pipeline is not unduly damaged due to ground movement in the immediate vicinity of the pipeline. **When performing a trenchless excavation parallel to a gas pipeline, the gas pipeline must be exposed at intervals of 25 feet or less to visually determine the pipeline's exact location.** Trenchless excavation is defined as drilling, directional drilling, boring, pile installation etc.

7 **Clearance:** Natural Gas pipelines require a **12 inch minimum separation from other underground structures** not associated with ENSTAR's pipeline system. Additional clearance from other underground structures may be required to allow proper maintenance and reduce the possibility of damage due to the proximity of other structures (49 CFR § 192.325.) This clearance requirement includes rigid insulation and geotextile fabrics. **ENSTAR requires a 36-inch minimum separation from certain electrical facilities, including any grounded components i.e. ground rods, non-insulated conductors and associated structures.**

8 **Pipeline Cover:** ENSTAR pipelines in public rights-of-way are generally installed with 36 inches to 48 inches of cover, and in private rights-of-way with 12 inches to 36 inches of cover. Projects that decrease cover or increase cover in excess of 60 inches must receive prior approval from ENSTAR Engineering Department (907) 264-3740**.** ENSTAR has limited ability to prevent the removal of cover over gas pipelines. Increasing pipeline cover more than 5 feet or decreasing pipeline cover to less than 3 feet may be considered a damage that may result in relocation of the gas pipeline at the expense of the Excavator. The depth of cover listed above cannot be assumed after installation. The excavator is responsible for any damage to ENSTAR pipelines regardless of the depth at which they are encountered.

9 **Inspection:** All excavations in the immediate vicinity of ENSTAR Natural Gas facilities (including backfill, compaction, temporary support, and shoring), is subject to prior approval and inspection by ENSTAR personnel. Transmission pipeline inspections are provided whenever an excavator is working within ten feet of a transmission pipeline. If it has been determined that there was excavation either by hand or machinery within 5 ft. of ENSTAR Natural Gas Distribution mains or 10ft. from ENSTAR Natural Gas Transmission mains without either locates or standby (qualified ENSTAR personnel), ENSTAR Natural Gas reserves the right to excavate to determine if there has been any damage to ENSTAR Natural Gas facilities. If damage has occurred ENSTAR Natural Gas has the right to charge the excavator for repairs.

Pipeline Components

Pipe Wall Protection

Dents, scrapes, gouges and scratches reduce pipeline wall thickness and affect the safety of the facility in two ways. First, the reduced wall thickness decreases the pressure at which the pipeline can safely operate. Second, the damage serves as a stress concentration that can cause a future brittle failure of the pipeline. **An ENSTAR representative must inspect each dent, scrape, gouge or scratch, no matter how small, before it is reburied.**

Corrosion Protection

ENSTAR's **steel** pipelines are protected from corrosion by a dielectric coating and an impressed current or galvanic anode cathodic protection system. Direct contact with metallic objects (a short) or removal of the protective coating can compromise this system. Contact the ENSTAR Engineering Department (907) 264-3740, whenever coating damage or a short is encountered. **An ENSTAR representative must inspect each short or section of damaged coating before it is reburied.**

Locate Wire Protection

ENSTAR's **polyethylene** pipelines are installed with a parallel copper wire, which is used to locate the pipeline. If the locate wire or wire coating is damaged, ENSTAR's ability to properly locate the pipeline may be severely compromised. Electrical continuity must be maintained. **An ENSTAR representative must inspect each possible locate wire damage before it is reburied.**

Service Line Excess Flow Valves

Excess Flow Valve (EFV) is a safety device installed in a natural gas service line near the gas main that is designed to automatically shut off the flow of natural gas in the event that the service line is broken. Effective February 12, 2010, all gas companies nationwide were required to install an EFV in any newly installed service line that serves one single family dwelling.

ENSTAR will not be installing EFVs on service lines that branch to multiple buildings, multi-family, commercial or industrial structures. ENSTAR will not be installing EFVs on the existing 100,000 service line currently in use.

What does this mean to you as an Excavator?

Should you dig into a natural gas service line that has an EFV, the gas will blow for a short duration and shut off automatically if the flow of gas is sufficient to close the EFV. Damages that do not sever the service line completely may not cause the EFV to close and the gas will continue to blow. Regardless, **you must report all damages to ENSTAR immediately**. EFVs are designed to allow a small amount of "bleed-by" so they can be reset without excavating the gas main. Backfilling a damaged service line with gas bleeding underground is extremely dangerous and could fuel an explosion if it is not repaired timely. **Do not assume a damaged service is dead or abandoned if it is not blowing gas**. The EFV may have shut down the flow of gas. Report all damages immediately by calling 277-5551.

Please remember that the vast majority of ENSTAR service lines WILL NOT have an EFV. Should you damage a service line without an EFV, gas will blow at full line pressure until ENSTAR can arrive to shut it off. Your best protection against damaging underground utilities is to call **811** for locates and hand dig within 2 feet of the locate marks.

What to do if You Damage a Gas Line or Smell Gas

If you damage a pipeline facility, call ENSTAR's 24-hour dispatch number at 277-5551. Call ENSTAR any time a gas line is broken, scraped, pulled, cut or otherwise damaged. **If the damage results in a release of natural gas and there is a danger to life or property, you should call the local Fire Department or 911.** Eliminate all ignition sources and evacuate the area of the damage. Wait for an ENSTAR employee to shut off the flow of gas and make repairs.

Gas lines that have been pulled, stretched, kinked or bent could be damaged underground away from where the line is connected. If you pull or stretch gas lines call ENSTAR at 277-5551 and an ENSTAR Representative will investigate for possible underground leakage.

Qualified Personnel Requirements

Only qualified individuals meeting all applicable requirements may perform work on ENSTAR Natural Gas Company facilities. At a minimum, such individuals must comply with applicable federal, state and local regulation, statutes, and ordinances.

For further information about ENSTAR, visit our web site @ www.enstarnaturalgas.com

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

SECTION VIII

MINIMUM RATES OF PAY

State of Alaska Wage Rate

Laborers' & Mechanics' Minimum Rates of Pay

Title 36. Public Contracts AS 36.05 & AS 36.10 Wage & Hour Administration Pamphlet No. 600 (Pamphlet 600) is hereby incorporated in its entirety. Pamphlet 600 is available for free download at http://labor.state.ak.us/lss/pamp600.htm.

The Municipality of Anchorage will include a paper copy of the wage rates in the signed Contract.

SECTION IX

AWWU DISADVANTAGED BUSINESS ENTERPRISE PROGRAM (MBE/WBE) (NOT USED)

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

SECTION X

EEO CONTRACT COMPLIANCE SPECIFICATIONS

EEO Special Provisions

EQUAL EMPLOYMENT OPPORTUNITY SPECIAL PROVISIONS

CONTRACT COMPLIANCE SPECIFICATIONS

Every municipal contract shall include language substantially the same as the following: The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, national origin, ancestry, age, sex, sexual orientation, gender identity, marital status, or physical or mental disability. The contract will comply with all laws concerning the prohibition of discrimination including, but not limited to, Title 5 and Title 7 of the Anchorage Municipal Code.

Every municipal contract shall state, in all solicitations or advertisements for employees to work under the contract, that all qualified applicants will receive consideration for employment without regard to race, color, religion, national origin, ancestry, age, sex, sexual orientation, gender identity, marital status, or physical or mental disability.

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

SECTION XI

RECORD DRAWINGS

(UNDER SEPARATE COVER)

SECTION XII

SOIL BORING LOGS (NOT USED)

SECTION XIII

TEMPORARY CONSTRUCTION PERMITS AND EASEMENTS (NOT USED)

SECTION XIV

PERMITS (NOT USED)

SECTION XV

TRAFFIC CONTROL PLANS (NOT USED)

SECTION XVI

ANNOTATED SITE PHOTOGRAPHS (NOT USED)

SECTION XVII

HAZARDOUS MATERIALS SURVEY REPORT (NOT USED)

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

SECTION XVIII

MAXIMO ASSET REPORTS

(NOT USED)

Equipment Organization and Classification Guide

Asset and Location Attributes Report

Municipality of Anchorage

Anchorage Water and Wastewater Utility

PUMP STATION 2 REHABILITATION

SECTION XIX

DRAWINGS (UNDER SEPARATE COVER)