BIDDING AND CONTRACT DOCUMENTS

FOR

CONSTRUCT BOGARD ROAD BOOSTER STATION

BID OPENING DATE & TIME: <u>MARCH 6, 2024 at 2:00 p.m.</u>

Prepared for:

CITY OF PALMER
231 W. Evergreen Avenue
Palmer, Alaska 99645
(907) 745-3271

Contact: Jude Bilafer, Public Works Director
phone: (907) 745-3400
email: jbilafer@palmerak.org

Prepared by:

HDL Engineering Consultants, LLC
1617 South Industrial Way Suite 3
Palmer, AK 99645
(907) 746-5230 phone

Contact: Chris Bowman, PE, Project Manager
email: cbowman@hdlalaska.com

FEBRUARY 2024

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

MASTER INDEX

CITY OF PALMER STANDARD SPECIFICATIONS, DATED 2018, MAY BE DOWNLOADED FROM THE CITY WEBSITE AT https://www.palmerak.org/public-works/page/standard-specifications-and-development-standards.

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

I

INVITATION TO BID

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

Invitation to Bid

Construct Bogard Road Booster Station

The City of Palmer is requesting bids from qualified contractors for the construction of the Bogard Road Booster Station as more fully described in the Contract Documents.

Sealed bids, in single copy, for furnishing all labor, equipment and materials and performing all work for the above project are hereby invited and must be received prior to **2:00 pm local time on WEDNESDAY, MARCH 6, 2024**, at Palmer City Hall, 231 W. Evergreen Avenue, Palmer, Alaska, at which time bids will be opened publicly and read aloud. Time of receipt will be as determined by the Customer Service Counter time stamp. Proposals received after the time specified will be returned to the Contractor unopened. Facsimile or email or any other electronic media submittals will not be accepted.

A non-mandatory pre-bid meeting will be held at the above address on **TUESDAY, FEBRUARY 20, 2024, at 10:00 am.** A site visit will follow. Submit all questions in writing to Crystal Dermer (cdermer@palmerak.org) by **WEDNESDAY, FEBRUARY 21, 2024, by 5:00 pm.**

This is a bonded, public works project. Contractors are required to be licensed by the City and State and shall comply with Title 36 wage rates. A bid guarantee is required with each bid in the amount of 10% of the base bid amount. Successful bidder will be required to provide separate payment and performance bonds and a labor and material payment bond each in the amount equal to 100% of the contract price.

Contract Documents will be available starting FEBRUARY 14, 2024, in electronic format only. Documents may be obtained from the City of Palmer website at https://www.palmerak.org/bids.

For additional info, contact the Palmer Public Works office at (907) 745-3400.

The City reserves the right to reject any or all bids and to waive irregularities or informalities in any of the bids.

John Moosey
City Manager

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

II

SPECIAL PROVISIONS

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

Construct Bogard Road Booster Station

INDEX TO SPECIAL PROVISIONS

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

Construct Bogard Road Booster Station

SPECIAL PROVISIONS

SECTION 95.01 LOCATION AND SCOPE

The proposed Work is located along Bogard Road, approximately one mile west of the City of Palmer corporate limits and is more particularly located on the design drawings. The Work included under this Contract consists of furnishing all labor, materials, equipment, supervision, and other facilities necessary to successfully complete the Work set forth in the Drawings and specifications. It shall be the responsibility of the bidder to prepare his/her bid so that all materials and/or fittings shall harmoniously conform to the intent of the Contract Drawings, Specifications, and Special Provisions.

Below are the schedules of Work that are presented in the Bid Proposal of this Contract:

SCHEDULE DESCRIPTION

A Base Bid – Construct Bogard Road Booster Station, Complete

- Construct Bogard Road Booster Station and associated site improvements as further described in the Contract Documents.

B Additive Alternate 1 – Pave Booster Station Pad

- Pave the Bogard Road Booster Station pad as further described in the Contract Documents.

Additive Alternates will be awarded in accordance with City of Palmer Standard Specifications Section 10 Article 3.4 Action on Bids.

SECTION 95.02 REFERENCE TO CITY OF PALMER STANDARD SPECIFICATIONS

This Contract is subject to and hereby incorporates by reference the 2018 City of Palmer Standard Specifications, hereinafter referred to as CPSS; the Alaska Traffic Manual - Manual on Uniform Traffic Control Devices (MUTCD), with the Alaska supplement latest edition; and the International Building Code, latest edition adopted by City of Palmer. When conflicts exist between CPSS and MUTCD, the requirements of CPSS and these Special Provisions shall govern.

SECTION 95.03 TIME OF COMPLETION

Work under this Contract shall be "substantially complete," as defined by CPSS Section 10.05 Control of Work, Article 5.34 Substantial Completion on or before October 31, 2024.

Final Acceptance of the work shall be obtained on or before November 30, 2024. Award of this Contract is expected at the March 26, 2024, City Council meeting.

SECTION 95.04 MODIFICATIONS AND/OR ADDITIONS TO CITY OF PALMER SPECIFICATIONS

The following listed provisions of CPSS are amended as hereinafter stated:

A. DIVISION 10 STANDARD GENERAL PROVISIONS

SECTION 10.02 BIDDING REQUIREMENTS AND CONDITIONS

Article 2.1 Examination of Bidding Documents and Site

Delete the last paragraph and replace with the following:

> The Contractor is required to protect, repair or replace existing improvements on private property that may be encountered during construction. Submission of a Bid is an admission that the Bidder has examined the site to determine extent of work required.

SECTION 10.03 AWARD AND EXECUTION OF CONTRACT

Article 3.6 Execution of Contract

Delete the first sentence of the fourth paragraph and substitute the following:

> The Contractor will be supplied with one (1) electronic file (PDF format) of the conformed Contract Documents, exclusive of City of Palmer Standard Specifications.

Add the following immediately after the fourth paragraph:

> Upon written request, one copy of the Engineer's CAD files will be provided to the Contractor for Contractor's use in project layout and staking. Files will be in AutoCAD 2024 format and will include base mapping and plan view design linework only. Engineer makes no representation as to accuracy or integrity of data and Contractor shall assume all risk with its use. The official plans shall be the printed set bearing the Engineer's seal and signature. CAD files shall be subject to provisions of Division 10, Article 4.21 Ownership of Contract Documents.

SECTION 10.04 SCOPE OF WORK

Article 4.8 Work Incidental to the Contract

Delete Article 4.8 in its entirety and substitute the following:

The lump sum price shown on the bid schedule shall constitute full compensation to provide the Owner with a complete and operable system. No additional payment shall be made for items not shown or indicated but still required to complete the work as shown on the Drawings.

Article 4.20 Operating and Maintenance Manuals

Add the following immediately after the first paragraph.

Operation and Maintenance Manuals shall include complete descriptions of the process control and instrumentation systems, including comprehensive graphical depictions (screen captures) of the control panel.

SECTION 10.05 CONTROL OF WORK

Article 5.3 Construction Progress Schedule and Schedule of Values

Delete the first paragraph and substitute the following:

> Within five (5) calendar days after execution of contract, the Contractor shall submit to the Engineer a Construction Progress Schedule in the form of a time-scaled bar chart or Critical Path Method (CPM) schedule, the elements of which shall be the significant bid items, at a minimum. Additional items shall be added to represent other significant features of the Work, such as the submittal schedule, material procurement and freighting. Weather and ground condition restraints, work suspensions and other significant influences on the Contract amount and/or time for completion of the Work shall be shown. The initial schedule shall be for the entire Work, and shall extend through project completion. The schedule shall be revised and submitted at two-week intervals with a report identifying changes to activities (start, finish, duration, or critical path), changes to Contract Time, and methods to recover from delays for each activity.

Article 5.5 Shop Drawings

Delete Article 5.5 in its entirety and substitute the following:

Within ten (10) days after the effective date of the Notice to Proceed and prior to commencement of the Work, the Contractor shall submit to the Engineer a submittal register listing every Shop Drawing or Product Data submittal required for the Project. Register shall include submittal number (based on Specification Section number) and description. Submittals shall be grouped by Specification Division. Submittals to the Engineer shall be by Specification Division and shall be comprehensive. Piecemeal submittals will be returned without review.

The Contractor shall submit to the Engineer electronic copies of those Shop Drawings required by the Contract Documents within a reasonable time and in such sequence as to cause no delay in the Work or in the work of the Owner or any separate contractor. A properly completed

Submittal Transmittal form shall accompany all submittals. If a substitution is being requested, a Substitution Request form shall be submitted with the appropriate backup documentation.

The Shop Drawings submitted by the Contractor shall bear his specific written and signed certification that he has verified: (1) that the Work shown is in conformance with the Contract Documents; (2) that he has determined and verified quantities, dimensions, field measurements, and related field construction criteria; and (3) that he has checked and coordinated the submittal with the requirements of the Work. The Contractor shall indicate on the Shop Drawing submittal any deviation from the requirements of the Contract Documents.

All Shop Drawings shall be clear and legible. Any Drawings submitted which appear to be carelessly prepared, erroneous, or unchecked shall be returned to the Contractor for further action, and resubmittal.

Within a reasonable time, the Engineer shall review and approve or take other appropriate action on the submittals, but only for conformance with the design concept of the Work and with the information given in the Contract Documents. The Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

The Engineer shall state the reasons for rejection and/or resubmittal requirements if applicable.

Revisions on re-submittals other than those requested by the Engineer on previous submittals shall be specifically noted by the Contractor.

Upon approval of the Shop Drawings by the Engineer, an electronic copy shall be returned to the Contractor.

The Engineer's approval of Shop Drawings does not relieve the Contractor of responsibility for any deviation from the Contract Documents unless the Contractor has submitted and received written approval of the Deviation Request. Errors and omissions that may occur in the Shop Drawings are the responsibility of the Contractor. The Contractor is not relieved of this responsibility by the Engineer's approval of the Shop Drawings.

When Shop Drawings are required on a portion of the Work, the Contractor shall not commence that portion of Work or any item relying on said portion of Work until such Shop Drawings have been given written approval by the Engineer.

The Contractor shall keep one copy of all Contract Documents, including modifications, and one copy of approved Shop Drawings in good order and available to the Engineer or his representative at the construction site.

Article 5.6 Product Data

Delete Article 5.6 in its entirety and substitute the following:

Within ten (10) days after the effective date of the Notice to Proceed and prior to commencement of the Work, the Contractor shall submit to the Engineer a submittal register listing every Shop Drawing or Product Data submittal required for the Project. Register shall include submittal number (based on Specification Section number) and description. Submittals shall be grouped by Specification Division. Submittals to the Engineer shall be by Specification Division and shall be comprehensive. Piecemeal submittals will be returned without review.

The Contractor shall submit for approval electronic copies of complete Product Data for those items for which submittals are required by the Contract Documents including, but not limited to, specific performance data, material description, rating, capacity, working pressure, material gage or thickness, brand name, catalog number, and operating and maintenance data. Submittals shall be submitted within a reasonable time and in such sequence as to not cause a delay in the Work, in the Work of the Owner, or any separate Contractor. A properly completed Submittal Transmittal form shall accompany all submittals. If a substitution is being requested, a Substitution Request form shall be submitted with the appropriate backup documentation.

The Product Data submittals shall bear the Contractor's specific written and signed certification that he has verified that the product data is in conformance with the contract documents; that he has determined and verified quantities, dimensions, field measurements, and related field construction criteria; and has checked and coordinated the submittal with the requirements of the work.

Within a reasonable time, the Engineer shall review and approve or take other action on the submittals. Approval by the Engineer is required before any of the equipment is ordered.

Product Data for equipment approved by the Engineer shall not in any case supersede the Contract Documents. The approval by the Engineer shall not relieve the Contractor from responsibility to correct deviations from Drawings or Specifications, unless he has notified the Engineer in writing of such deviations at the time of submission and secured the Engineer's written approval. The Contractor shall not be relieved from responsibility to correct errors of any sort in the items submitted. The Contractor shall check and approve the item described by the Product Data with the Contract Documents for deviations and errors prior to submittal to the Engineer for approval. The Contractor shall ensure that items to be furnished fit the space available as shown in the Contract Documents.

Contractor shall furnish copies of Product Data of all equipment or components with approved Operating and Maintenance Manuals.

Submittals are required for all materials to be used in the work, including materials specified in Division 20. For Division 20 materials, the submittal shall include the source of the material, gradation analysis results, and plasticity index, fracture count, etc. as appropriate to the material to certify the material meets the specifications. Material submittal data shall be representative and performed within the last two years.

Article 5.8 Testing of Materials

Delete the first paragraph and substitute the following:

All tests shall be made in accordance with methods as described and designated in the Contract Documents. When tests of materials are required on site, such tests shall be provided by and at the expense of the Contractor, unless otherwise specified. All factory testing, mill testing and other off site testing shall be as specified or required to conform with codes and industry standards and provided by and at the expense of the Contractor. The Owner may, at its option, perform additional field and laboratory testing for quality assurance. Special Inspections as indicated on the Plans shall be provided by and at the expense of the Owner.

Add the following to the end of the Article:

Minimum testing shall be as follows:

Material	Test	Frequency
Classified Fill and Backfill	Gradation	1 per source
	Plasticity Index	1 per source
	Maximum Density	1 per source
	Field Density	1 per 100 sy per 12-inch lift
Leveling and Surface Course	AASHTO M-147 Quality	At least 1 per source and as required by changes in material
	Coarse Aggregate Wear	At least 1 per source and as required by changes in material
	Coarse Aggregate Fractured Face	1 per source
	Gradation	1 per source
	Maximum Density	1 per source and as required by changes in material
	Field Density	1 per 100 sy
Exterior Concrete	Coarse Aggregate Gradation	At least 1 per source
	Fine Aggregate Gradation	At least 1 per source
	Composite Aggregate Gradation	At least 1 per source
	Slump	Up to 10 cy/day: 1 Greater than 10 cy/day: 1 per 50 cy or portion thereof, not less than 2
	Air Entrainment	Up to 10 cy/day: 1 Greater than 10 cy/day: 1 per 50 cy or portion thereof, not less than 2
	28-day Compressive Strength	Up to 10 cy/day: 1 Greater than 10 cy/day: 1 per 50 cy or portion thereof, not less than 2
Topsoil	Gradation	At least 1 per source and as required by changes in material
	Organic content	At least 1 per source and as required by changes in material
	Soil chemical content	At least 1 per source and as required by changes in material

Article 5.27 Liquidated Damages

Delete the entire first paragraph and substitute the following:

The Owner may withhold from any progress payment the sum of $1,000.00 per day as Liquidated Damages for each and every calendar day that Substantial Completion of any Work Area is delayed beyond the Substantial Completion Date. After substantial completion, the Owner may withhold out of any progress payment the sum of $1,000.00 per day as Liquidated Damages for each and every calendar day that Final Acceptance is delayed beyond the Contract Completion Date. If no money is due Contractor, the Owner shall have the right to recover said sums from Contractor, the Surety, or both.

Article 5.34 Substantial Completion

Delete the last paragraph and substitute the following:

For the work to be considered Substantially Complete, all booster station components shall be fully operational with ADEC Interim Approval to Operate, operator training and system commissioning shall be complete.

SECTION 10.06 LEGAL RELATIONS AND RESPONSIBILITIES

Add the following new Article 6.19 Payments to Contractors and Subcontractors:

Article 6.19 Payments to Contractors and Subcontractors

Payment to Contractors and Subcontractors shall comply with the provisions of Alaska Statute 36, Section 36.90, Article 3 entitled “Public Construction Contract Payment.”

SECTION 10.07 MEASUREMENT AND PAYMENT

Article 7.1 Method of Measurement

Delete Article 7.1 in its entirety and substitute the following:

Materials incorporated into this project will not be measured for payment on an individual basis. Any reference to measurement and payment by unit prices shall not apply to this Contract.

Article 7.2 Scope of Payment

Delete the second paragraph of Article 7.2 in its entirety and substitute the following:

Method of measurement will be on a lump sum basis, as described herein and shown on the bid schedule, and shall constitute full compensation to provide the Owner with a complete and operable system. Payment shall be in accordance with CPSS, Division 10.00 Standard General Provisions, Section 10.07 Measurement and Payment.

Article 7.7 Final Payment

Add the following to the end of the article:

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.
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, of surplus materials, rubbish, and similar elements
6. Approved red lines for record drawings

B. DIVISION 20 STANDARD CONSTRUCTION SPECIFICATIONS FOR EARTHWORK

SECTION 20.22 LEVELING COURSE

Change all instances of the phrase "Leveling Course" to read "Leveling and Surfacing Course". Insert the following gradation table under Article 22.2, Paragraph C:

Surface Course

U.S. Std. Sieve	Cumulative % Passing by Weight
1"	100
3/4"	70-100
3/8"	50-85
#4	35-65
#8	20-50
#50	15-30
#200	8-15

*In addition to the grading limits stipulated above, fractions passing the #200 sieve shall not be greater than seventy-five percent (75%) of the fractions passing the #50 sieve.

C. DIVISION 30 STANDARD CONSTRUCTION SPECIFICATIONS FOR PORTLAND CEMENT CONCRETE

SECTION 30.01 GENERAL

Article 1.1 Scope of Work

Delete the Article in its entirety and substitute the following:

The Work covered in this Section consists of providing all plant, labor, equipment, supplies, material, transportation, handling, storage, and protection for performing all operations in connection with the placement of Portland Cement Concrete outside of the building footprint, in accordance with the Specifications and Drawings.

SECTION 30.07 CONCRETE – BUILDING STRUCTURES

Delete the Section in its entirety. Material and Installation Specifications for the building, booster station piping, mechanical, electrical, and SCADA systems are included on the Plans and Specifications:

The Work covered in this Section consists of providing all plant, labor, equipment, supplies, material, transportation, handling, storage, and protection for performing all operations in connection with the placement of Portland Cement Concrete outside of the building footprint, in accordance with the Specifications and Drawings.

D. DIVISION 60 STANDARD CONSTRUCTION SPECIFICATIONS FOR WATER SYSTEMS

SECTION 60.02 FURNISH AND INSTALL PIPE

Article 2.1 Material

Insert the following immediately after Item L:

M. Stainless Steel Pipe

Stainless Steel Pipe shall conform to the requirements of ASTM A312 or ASTM A778, Type 316L, annealed, pickled, and passivated. Exposed pipe shall be Schedule 10 thickness. All stainless-steel welds, heated areas of stainless steel plates or shapes, and heat affected zones of stainless steel welds shall be cleaned, descaled, and passivated per ASTM A380 and ASTM A967.

SECTION 60.06 WATER SERVICE LINES

Article 6.1 General

Add the following to the end of the article:

Concrete manholes and vaults shown on drawings shall conform to the material and construction standards defined in Section 50.03 Sanitary Sewer Manholes, unless noted otherwise.

Frames and covers shall conform to the material and construction standards defined in Section 50.04 Watertight Manhole Frames and Cover, unless noted otherwise. Lettering shall read WATER. Furnish and install frost plug, 4-inch Cryoflex or approved equal.

Article 6.2 Material

Insert the following immediately after Item F:

G. Potable Water Meter

Water meter shall be 8-inch E-Series G2 Ultrasonic Meter as manufactured by Badger Meter, Inc., no equal. Meter shall carry an NSF 61 listing.

Meter connector shall be Twist Tight In-line Connector Assembly as manufactured by Badger Meter, Inc., no equal.

Meter endpoint shall be Orion Cellular Endpoint, LTE-M on AT&T Network as manufactured by Badger Meter, Inc., no equal.

H. Valve, Large-Diameter Service Connection

Gate valves shall be ductile iron body resilient wedge type rated for 250 psi cold water working pressure, and in full compliance with AWWA C515 and NSF Standard 61. The wedge shall be ductile iron encapsulated in nitrile rubber, and shall seat equally well against flow in either direction. The stem and wedge nut shall be manganese bronze. All exposed interior and exterior surfaces of the valve body, bonnet, and stuffing box shall have a fusion bonded epoxy coating, complying with AWWA C550, applied electrostatically prior to valve assembly. Gate valves shall be Outside Screw and Yoke type, with a triple O-ring seal. Gate valves shall have a hand wheel, and shall open counter-clockwise. Gate valves shall have flanged ends.

E. DIVISION 70 STANDARD CONSTRUCTION SPECIFICATIONS MISCELLANEOUS

SECTION 70.13 BOLLARDS

Article 13.3 Construction

Add the following to the end of Item B:

In areas not designated to receive surface improvements, bollards shall extend to 6 feet above finished grade. A delineator shall be installed at each bollard and extend 5 feet above the bollard. Delineator shall be Carsonite Model SNFB Snow Pole, or approved equal.

F. DIVISION 80 STANDARD CONSTRUCTION SPECIFICATIONS FOR TRAFFIC SIGNALS AND ILLUMINATION

Delete Division 80 in its entirety. Material and Installation Specifications for the building, booster station piping, mechanical, electrical, and SCADA systems are included on the Plans and Specifications.

END OF SPECIAL PROVISIONS

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

ADDITIONAL PROJECT SPECIFICATIONS

THIS PAGE INTENTIONALLY LEFT BLANK

BIDDING AND CONTRACT DOCUMENTS

Table of Contents

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 01

GENERAL REQUIREMENTS

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01 75 00 – STARTING AND ADJUSTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Facility Startup

1. Functional Testing

2. Startup Test Period

3. Demonstration and Training

B. The CONTRACTOR shall perform equipment and systems Starting and Adjusting as described herein. The provisions of this section shall apply to all equipment and systems, and specific testing requirements found elsewhere in these Documents shall be considered complementary, and testing requirements in both sections shall apply.

C. Related Requirements:

1. City of Palmer Standard Specifications as Modified by the Special Provisions

a. Standard Construction Specifications for Water Systems Division 60

2. AWWA C651

3. Alaska Department of Environmental Conservation Approval to Construct

4. Section 40 90 00 Process Control and Instrumentation Systems

1.2 DEFINITIONS

A. Manufacturer (Equipment Supplier): The entity which fabricates and furnishes the equipment specified for inclusion in the Work.

B. Manufacturer's Representative: The person with requisite qualifications designated, trained, and directed by the Manufacturer (Equipment Supplier) to perform Manufacturers' Services as required by these Contract Documents.

C. Facility Startup: Process of putting the Project in operating order. 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. Functional Testing of equipment and systems.

3. Operation of the system over the period specified for Startup Test Period to verify system operation and performance.

D. Functional Test: A test or tests in the presence of the OWNER to demonstrate that the installed equipment and systems meet functional performance requirements including, but not limited to: noise, vibration, alignment, speed, proper electrical and mechanical connections, thrust restraint, proper rotation, and initial servicing.

E. Operation Period: The operation period begins when the facility has been successfully started up as defined under Paragraph 1.2.H.2 Startup Test Period and has met all Substantial Completion requirements.

F. Significant Interruption: May include any of the following events:

1. Failure of CONTRACTOR to maintain qualified onsite startup personnel as scheduled.

2. Failure to meet specified performance for more than 2 consecutive hours.

3. Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within 5 hours after failure.

4. Failure of noncritical unit systems, or subsystem that is not satisfactorily corrected within 8 hours after failure.

5. As may be determined by ENGINEER.

G. Control System Commissioning: Testing and Commissioning administered by the CONTRACTOR, equipment manufacturers, and the CONTRACTOR'S Control System Panel Designer and Fabricator (CSPDF) following Functional Tests and Performance Tests by the CONTRACTOR and OWNER.

H. 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, ENGINEER, and manufacturers' representatives for equipment items and systems after all required Functional Tests have been completed and any additional testing 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, through the ENGINEER, the facility or designated portion has operated in the manner intended for 3 continuous days without Significant Interruption. This period is in addition to Functional Testing specified elsewhere. Operator Training may occur concurrently with the Startup Test Period. A Significant Interruption will require the startup then in progress to be stopped and completely restarted after corrections are made.

3. The CONTRACTOR'S CSPDF will provide SCADA system programming and commissioning to facilitate operation and monitoring of newly installed equipment during the Startup Test Period.

1.3 INSTRUMENTATION AND CONTROLS

A. CONTRACTOR's Control System Panel Designer and Fabricator

1. Qualifications and responsibilities per Section 40 90 00.

B. CONTRACTOR's work scope includes but is not limited to:

1. Furnishing and installing new electrical infrastructure hardware such as cabling, raceways, panels, and modifications to existing control panel components.

2. Furnishing and installing new control devices and instrumentation including calibration, on-site configuration and startup testing per Section 40 90 00 Process Control and Instrumentation Systems.

3. Testing of power, communications, and control circuits between Project components.

4. Developing, loading, or troubleshooting automation and control programming for computers, or programmable logic controllers (PLCs) supplied by the equipment manufacturers.

5. Developing a Control System Commissioning plan (which will be reviewed and approved by the OWNER, through the ENGINEER).

1.4 SUBMITTALS

A. Startup Plan. CONTRACTOR shall furnish a Startup Plan 60 calendar days in advance of Facility Startup. The Startup Plan must complement CONTRACTOR's schedule. Plan shall include:

1. Completion date for pre-startup activities including scheduled shut downs and preparation activities, temporary equipment installation, and new equipment installation completion as applicable. The Startup Plan must identify those activities that may be performed concurrently and those that must be deferred or delayed until completion of other activities.

2. List of Manufacturer's Representatives, their requisite qualifications, and length of stay for those to be on site for Facility Startup.

3. Facility Startup Schedule. Schedule shall provide hourly details for each component of the Facility Startup, including start and end times for Functional Testing and Startup Test Period.

4. Flushing, Disinfection, and Pressure Testing Plan.

5. Control System Commissioning Plan.

6. Operator Training Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, and length of instruction time. Schedule training with OWNER, through ENGINEER. Include learning objective and outline for each training module. Topics shall include:

a. Basis of System Design

b. Emergencies

c. Operation and Adjustments

d. Troubleshooting and Repairs

e. Maintenance

f. Operation and Maintenance Manuals

1.5 COORDINATION WITH SUBCONTRACTORS

A. For Facility Startup, CONTRACTOR shall provide the following on-site resources:

1. A journeyman pipefitter

2. A journeyman electrician

3. CONTRACTOR's project superintendent

4. CONTRACTOR's CSPDF

5. Manufacturer's Representatives

6. Tools, equipment, and miscellaneous materials for the pipefitter and electrician appropriate for undertaking troubleshooting efforts for the systems, equipment, and controls.

1.6 SUPPORT FOR SYSTEM INTEGRATION SERVICES

A. The CONTRACTOR will provide Instrumentation and Control System commissioning required for manual and automated control of the Project's Systems.

B. During the Control System Commissioning for the Project's Systems, the CONTRACTOR'S CSPDF will:

1. Be present at the Project site to collaborate with each individual Manufacturer's representative during their onsite inspections and startup activities.

2. Verify performance of process equipment control in both manual and automated control modes functions in accordance with the control requirements of these Project Specifications.

3. Document and provide OWNER written notification of any failures in achieving process control performance requirements stipulated in these Project Specifications.

4. Simulate all alarm conditions for proper function and notification.

C. Verification of functional performance of the process instrumentation and control system is the responsibility of CONTRACTOR:

1. As applicable, confirm the following operation and control features:

a. Pump delivery rate(s) – pressure and flow

b. Permissives for equipment cycling

c. Emergency stop controls

d. Alarm operation

e. Operation under standby power

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MANUFACTURERS' SERVICES

A. Travel to OWNER'S Bogard Booster Station is required for Functional Testing preparation, assistance during Startup Test Period, and for Operator Training, for the following equipment. Depending on CONTRACTOR'S sequence of construction, multiple separate site visits may be required.

1. Booster Pumps: P-1, P-2, P-3, and P-4

2. Chemical Metering Pump: IP-1

3. Chlorine Analyzer: AIT 651

4. Standby Generator

3.2 FUNCTIONAL 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, instrument systems, disinfection, pressure testing, Bogard water connection, and Colony service connection.

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.

B. Cleaning and checking:

1. Prior to starting Functional Testing:

a. Obtain an approved Startup Plan

b. Obtain completion of applicable portions of Manufacturer's Certification of Proper Installation

C. Ready-to-test determination will be by OWNER, through ENGINEER, based at least on the following:

1. Notification by CONTRACTOR of equipment and system readiness for testing.

2. Acceptable Startup Plan.

3. Acceptable Operation and Maintenance Manuals.

4. Adequate completion of Work adjacent to, or interfering with, equipment to be tested.

5. Availability of Manufacturer'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.

3.3 FUNCTIONAL TESTING – GENERAL

A. Commence and conduct testing per approved Startup Plan and Manufacturer's requirements.

B. Provide the following:

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

a. Flushing from Bogard connection to Colony shall be performed concurrently. Flushing shall be through mainline hydrant west of North 49th State Street. OWNER shall operate hydrant. CONTRACTOR shall coordinate operations with OWNER through ENGINEER.

b. Disinfection Verification Coliform Sampling shall be performed immediately after flushing.

2. Prior to Startup Test Period, CSPDF shall complete functional verification of all process operational features, and instrumentation and control functions while in an automated operational mode.

a. Automated operation shall be demonstrated by varying flows through mainline hydrant west of North 49th State Street.

3. After demonstration of operational features CONTRACTOR shall allow for interim water service to Colony.

   a. Satisfactory results of Disinfection Verification Coliform Sampling are required prior to interim water service.

   b. Interim water service shall be provided on the Saturday immediately preceding Startup Test Period and remain active until the Startup Test Period, to allow for Colony to complete flushing and water supply transition.

C. Startup Test Period shall not commence until the equipment or system meets the specified Functional Tests.

3.4 STARTUP TEST PERIOD

A. Shall commence on a Monday in which school is in session.

B. When Startup Test Period has commenced, schedule remaining Work so as not to interfere with or delay the completion of Startup Test Period. Support the Startup Test Period 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 the Startup Test Period.

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 the successful Startup Test Period is complete, and reports submitted, and Manufacturers' services completed for training of OWNER's personnel.

END OF SECTION 01 75 00

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 03

CONCRETE

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

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

1. Footings.

2. Slabs-on-grade.

1.2 DEFINITIONS

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

B. Cold Weather: ACI 306, Cold weather condition are met when the air temperature has fallen to, or is expected to fall below, 40 degrees Fahrenheit during the concrete placement or protection period.

1. Protection Period: See Section 3.

C. Hot Weather: ACI 305R. Work plans shall include preparation to limit the temperature effects on concrete. As the selected limiting temperatures, usually but not always between 75 degrees Fahrenheit to 100 degrees Fahrenheit is approached and exceeded, unfavorable effects of high temperature are likely.

1.3 SUBMITTALS

A. Product Data: For the following, as applicable:

1. Steel reinforcing.

2. Admixtures.

3. Waterstops.

4. Curing Compounds.

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. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates.

D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

E. Field quality-control reports.

F. Cold-Weather Placement and Protection Plan: Required only when placement and/or curing will be done during cold weather as defined in earlier section.

1. Placement Plan: For each concrete pour. Submit methods for batch plant aggregate heating, surface preparation plan including massive embedment identification and heating, subgrade thawing, and concrete temperature protection during placement.

2. Protection Plan: Submit methods for temperature protection, plan for monitoring and recording concrete temperature, and methods for testing of in-place concrete strength.

1.4 QUALITY ASSURANCE

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

B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated. Agency shall be qualified and shall meet all requirements to operate in the state of Alaska.

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

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

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

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

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

2.2 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1-inch.

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

2.4 CONCRETE MIXTURES

A. Plant Mix:

1. Strength:

   a. Exterior structural application (building foundations): 4500 psi concrete with 6 ± 1.5 percent air entrainment.

   b. Interior structural application (floor slabs, housekeeping pads etc): 4500 psi concrete with zero air entrainment additives.

2. Proportions: ACI 211:1.

3. Cement:

   a. Use Portland Cement, ASTM C 150, of the same type, brand, and source, throughout Project: Quantity as needed for concrete strength.

4. Aggregates:

   a. ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.

   b. Maximum aggregate size to be 3/4-inch minus for finished slabs and curbs, 75 percent of minimum clear space between steel or between steel and forms in formed concrete and 3/8-inch for grouting concrete masonry.

   c. Fine Aggregate to be free of materials with deleterious reactivity to alkali in cement.

5. Water:

   a. ASTM C 94/C 94M and potable.

   b. Maximum Water/Cement ratio: 0.45.

6. Slump of concrete: Slump of concrete shall not be changed by addition of water at the jobsite unless indicated on batch ticket, added water shall not exceed that indicated on batch ticket. Super-plasticizers shall be used to change the slump as indicated on the concrete plant batch ticket.

   a. 8 inches maximum at truck chute discharge point when using plasticizers.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

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

   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

   2. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

2.6 CURING MATERIALS

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

B. Water: Potable.

2.7 RELATED MATERIALS

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

2.8 FABRICATING REINFORCEMENT

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

2.9 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 degrees Fahrenheit, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees Fahrenheit, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

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

B. The sole responsibility for form design and for any resulting structural damage due to form failure rests with the Contractor.

3.2 EMBEDDED ITEMS

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

3.3 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing 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 would reduce bond to concrete.

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

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

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

3.5 JOINTS

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

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

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct and locate contraction joints per drawings.

3.6 WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.7 CONCRETE PLACEMENT

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

B. Water is only to be added per instructions as written on the batch ticket.

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 will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

2. 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.

F. Cold-Weather Placement: When cold weather conditions exist or are anticipated during placement and or curing comply with ACI 306.1, Standard Specification for Cold Weather Concreting and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. Surface Preparation

a. Do not place concrete on snow, ice, standing water, or frozen subgrade.

2. Concrete Mix

a. Minimum concrete temperature when batched is as follows. Listed ambient air temperature is that predicted at time of concrete placement:
   1) Air temperature above 30 degrees Fahrenheit: 60 degrees Fahrenheit
   2) Air temperature between 0 and 30 degrees Fahrenheit: 65 degrees Fahrenheit
   3) Air temperature below 0 degrees Fahrenheit: 70 degrees Fahrenheit

b. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

c. Do not use frozen materials or materials containing ice or snow. Submit method for heating aggregate.

d. Avoid water temperatures that could cause flash setting.

e. For flatwork, use low slump concrete to mitigate problems due to bleed water.

3. Delivery

a. Minimum concrete delivery temperature of 55 degrees Fahrenheit.

b. Any water added on site to the concrete mix shall not be less than 55 degrees Fahrenheit.

G. Inclement weather

1. Protect freshly placed concrete against damage by infiltration of any adverse weather. when damage might occur: (1) stop the concrete placement against the nearest construction joint or bulkhead and (2) cover the concrete at once with waterproof protection until concrete has set.

2. Sprayed-on protective coatings: apply in accordance with manufacturer's written instructions. protection from rain, air moisture, or large temperature ranges shall be provided in accordance with the manufacturer's instructions.

3.8 FINISHING FLOORS AND SLABS

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

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to interior slabs.

2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10 feet long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16-inch.

C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.9 MISCELLANEOUS CONCRETE ITEMS

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

3.10 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 pounds/square foot 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. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. 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.

2. 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.

E. Cold Weather Protection: When cold weather conditions exist or are anticipated during placement and or curing, protect concrete according to ACI 306.1, Standard Specification for Cold Weather Concreting and as follows:

1. Protection Period

   a. Maintain a minimum concrete surface temperature of 55 degrees Fahrenheit during the protection period.

   b. Protection Period Duration: Maintain the required minimum surface temperature for the maximum applicable duration below:
      1) 3 days.
      2) 5 days for concrete foundations including thickened edge slabs.
      3) Until a minimum strength of 3500 psi has been reached
         a) Test in-place strength of concrete using cylinders cured on-site in the same weather conditions as the placed concrete, or other pre-approved method.

   c. Do not remove formwork during protection period.

d. Submit plan for concrete temperature protection during the protection period, including temperature monitoring of the concrete. Avoid overheating and drying concrete surfaces.

e. Test and report concrete temperature per Field Quality Control requirements.

2. Protection Termination

a. Following the minimum protection period, gradually cool the concrete surface by no more than 50 degrees Fahrenheit over a 24-hour period until the concrete surface temperature is within 20 degrees of the ambient air temperature at which point protection may be removed.

3.11 CONCRETE SURFACE REPAIRS

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

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

C. 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 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.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Steel reinforcement placement.

2. Verification of use of required design mixture.

3. Concrete placement, including conveying and depositing.

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

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture from 0 to 25 cubic yards, plus one set for each additional 50 cubic yard or fraction thereof.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 degrees Fahrenheit and below and when 80 degrees Fahrenheit and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M.

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

6. 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. 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.

7. 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.

8. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

E. Cold Weather Concrete Temperatures:

1. Concrete Placement: Measure and record concrete temperature of each truck or site-mixed batch immediately prior to placement on-site.

2. Concrete Protection: Measure and record concrete temperature at regular time intervals, at least twice every 24-hours.

END OF SECTION 03 30 00

DIVISION 04

MASONRY

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

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

1.2 DEFINITIONS

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

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

1.3 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 in TMS 402/602.

1.4 SUBMITTALS

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

B. Qualification Data: For testing agency.

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

1. Masonry units.
   a. Include data on material properties.
2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.

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

1. Include test reports for mortar mixes complying with compressive strength, water retention, and air content requirements of ASTM C 270.

2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.5 QUALITY ASSURANCE

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

B. 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.

C. 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.

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

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 designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and 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 PROJECT 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 ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 degrees Fahrenheit and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

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

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

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

2.2 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.

B. Integral Water Repellent: Provide units made with integral water repellent.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

C. Decorative CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2,0000 psi.

2. Density Classification: Normal weight.

3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.

4. Pattern and Texture:

a. Standard pattern, split-face finish.

5. Colors: As selected by Architect from manufacturer's full range.

2.3 MASONRY LINTELS

A. Masonry Lintels: Built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

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.

E. Mortar Cement: ASTM C 1329.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

G. 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. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C 404.

I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.

J. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and 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.

2.7 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. Use portland cement-lime masonry cement or mortar cement mortar unless otherwise indicated.

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. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. 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 all masonry construction, use Type S.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of Portland cement by weight.

2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.

3. Mix to match Architect's sample.

4. Application: Use pigmented mortar for exposed mortar joints with the following units:

a. Split-faced CMUs.

E. 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 Table 1.15.1 in TMS 602 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 3,000 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. Verify that foundations are within tolerances specified.

2. Verify that reinforcing dowels are properly placed.

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

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 the 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.

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 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 racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar 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.

3.5 MORTAR BEDDING AND JOINTING

A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

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

C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 LINTELS

A. Provide masonry lintels where shown and where openings of more 24 inches for block-size units are shown without structural steel or other supporting lintels.

3.7 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 402/602.

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 402/602 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.

3.8 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections: Level C special inspections according to the TMS 402/602.

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.

3. Place grout only after inspectors have verified mix design, slump, and proportions of site-prepared grout.

C. Testing Frequency: One set of tests for each 5000 square feet of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

E. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

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

3.9 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. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

3. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.10 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.

B. Excess Masonry Waste: Remove excess clean masonry waste and other masonry waste and legally dispose of off Owner's property.

END OF SECTION 04 22 00

DIVISION 05

METALS

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SCOPE:

A. Section Includes:

1. Bridge crane structural steel.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

A. Product Data: For the following, as applicable:

1. Primer.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

4. Identify members and connections of the seismic-load-resisting system.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."

1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone rectification.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992 or ASTM A 572, Grade 50.

B. Angles, Plates, Bar, and Channels: ASTM A 36.

C. Square/Rectangular and round HSS: ASTM A 500 Grade C.

D. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

2.3 PRIMER

A. Primer: Steel shall be delivered shop primed.

2.4 GROUT

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

2.5 FABRICATION

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

1. Fabricate beams with rolling camber up.

2. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.

3. Mark and match-mark materials for field assembly.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

2.6 SHOP CONNECTIONS

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

1. Joint Type: Pre-tensioned unless indicated otherwise in drawings.

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

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces to be field welded.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the coating manufacturer’s requirements but not less than following specifications and standards:

1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.8 FABRICATOR QUALITY CONTROL

A. Testing Agency: Engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports. Minimum testing agency qualifications per Part 1 of this specification.

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

2. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.

a. All shop welds are to be visually inspected.

3. Inspections listed above are not required where the work is done on the premises of a fabricator registered and approved to perform such work without special inspection, AWS Certified Fabricator or approved equivalent.

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

1. Additional testing, at Contractor’s expense, will be performed to determine compliance of corrected Work with specified requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with steel Erector present, verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

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

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

1. Set plates for structural members on wedges, shims, or setting nuts as required.

2. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

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

D. Do not use thermal cutting during erection.

E. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

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

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

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

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections. Minimum testing agency qualifications per Part 1 of this specification.

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

C. Welded Connections:

1. All field welds will be visually inspected according to AWS D1.1/D1.1M.

a. In addition to visual inspection, field welds may be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

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

END OF SECTION 05 12 00

DIVISION 06

WOOD, PLASTICS, AND COMPOSITES

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Structural framing and sheathing.
2. Miscellaneous wood framing and sheathing.
3. Blocking and framing for wall and roof openings.

1.2 DEFINITIONS

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

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

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NLGA: National Lumber Grades Authority.
2. WWPA: Western Wood Products Association.

1.3 SUBMITTALS

A. Product Data:

1. Power driven Fasteners.
2. Dowel Type Fasteners.
3. Expansion Anchors.
4. Wood Connectors.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber 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, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory Moisture Content of Lumber: maximum 19 percent unless otherwise indicated.

B. Mark each treated item with the AWPB Quality Mark Requirements.

C. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment and to comply with AWPA MR. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

D. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

2.2 DIMENSION LUMBER FRAMING

A. Framing: No. 2 or better grade.

1. Application: Roof eave and rake framing and other locations as indicated in the drawings.

2. Species:

a. Douglas fir-larch; WCLIB or WWPA.

2.3 CONSTRUCTION PANELS

A. Construction Panel Standards: Comply with PS 1" US Product Standard for Construction and Industrial Plywood" for plywood panels and, for products not manufactured under PS1 provisions, with American Plywood Association (APA) "Performance Standard and Policies for Structural-Use Panels", Form No E445.

B. Trademark: Factory-mark each construction panel with APA trademark evidencing compliance with grade requirements.

C. Concealed APA Performance-rated Panels: Where construction panels will be used for the following concealed types of applications, provide APA Performance-Rated Panels complying with requirements indicated for grade designations, span rating, exposure durability classifications, edge detail (where applicable) and thickness.

1. Roof Sheathing: APA RATED SHEATHING:

a. Plywood.

b. Exposure Durability Classification: Exposure 1.

c. Edge Detail – Square.

d. Thickness per drawings.

2.4 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. For items of dimension lumber size, provide No. 2 or better grade lumber of any species.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that 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.

C. NES NER-272 covers power-driven staples, nails, P-nails, and allied fasteners.

D. Power-Driven Fasteners: NES NER-272.

E. Wood Screws: ASME B18.6.1.

F. Lag Bolts: ASME B18.2.1.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

H. Wood Connectors: Provide Simpson Strong-tie connectors or equal, as indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

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

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

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

E. Sort and select lumber so that natural characteristics will 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.

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

G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated on Drawings. If fastening is not indicated comply with the following:

1. NES NER-272 for power-driven fasteners.

2. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code.

H. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

3.2 PROTECTION

A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 06 17 53 - FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Wood roof trusses.
2. Wood truss bracing.
3. Metal truss accessories.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for roof sheathing.

1.2 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

B. Qualified Professional Engineer: Professional Civil Engineer or Structural Engineer, licensed in the State of Alaska.

1.3 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
5. Show splice details and bearing details.

B. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.

D. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss fabricating firm.

1.4 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.

2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Engineer and authorities having jurisdiction] [and] [is certified for chain of custody by an FSC-accredited certification body.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations in TPI BCSI**,** "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.

2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.

3. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer as defined within Part 1 of this specification to design metal-plate-connected wood trusses.

B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

1. Design Loads: As indicated.

2. Maximum Deflection Under Design Loads:

a. Roof Trusses:
1) Live or snow load vertical deflection of 1/240 of span.
2) Total load vertical deflection of 1/180 of span.

C. Comply with applicable requirements and recommendations of the following publications:

1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."

2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."

3. TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded 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. Provide dressed lumber, S4S.

3. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

B. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal for both top and bottom chords.

C. Minimum Specific Gravity for Top Chords: 0.50.

D. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 06 10 00 "Rough Carpentry."

2.3 METAL CONNECTOR PLATES

A. Source Limitations: Obtain metal connector plates from single manufacturer.

B. General: Fabricate connector plates to comply with TPI 1.

C. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036-inch thick.

1. Use for interior locations unless otherwise indicated.

2.4 FASTENERS

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

1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.

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

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

A. Provide truss ties, straps, clips, and collectors as indicated on Drawings, substitutions shall be approved by Engineer.

B. 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.

C. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches wide by 1-inch deep by 0.040-inch thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

2.6 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install trusses and temporary bracing according to the latest edition of the BCSI booklet.

E. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Bracing material to comply with Section 06 10 00 "Rough Carpentry." Install bracing according to the latest edition of the BCSI booklet, including BCSI-B3 “Permanent Restraint/Bracing of Chords & Web Members”.

F. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

G. Space trusses as indicated; adjust and align trusses in location before permanently fastening.

H. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.

I. Install wood trusses within installation tolerances in TPI 1.

J. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

K. Replace wood trusses that are damaged or do not meet requirements.

1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Engineer.

3.2 REPAIRS AND PROTECTION

A. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

END OF SECTION 06 17 53

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 06 83 16 – FIBERGLASS REINFORCED PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Fiberglass reinforced plastic panels.

2. Trim.

1.2 REFERENCE STANDARDS

A. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.

B. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2017.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

1.3 SUBMITTALS

A. 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 PANEL SYSTEMS

A. Wall and Ceiling Panels:

1. Panel Size: 4 by 8 feet.

2. Panel Thickness: 0.10-inch.

3. Surface Design: Embossed.

4. Color: As indicated on drawings.

5. Attachment Method: Adhesive only, sealant joints, no trim.

2.2 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.

2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

B. Trim: Vinyl; color coordinating with panel.

C. Fasteners: Nylon rivets.

D. Adhesive: Type recommended by panel manufacturer.

E. Sealant: Type recommended by panel manufacturer; white.

PART 3 - EXECUTION

3.1 INSTALLATION - WALLS AND CEILINGS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Pre-drill fastener holes in panels, 1/8-inch greater in diameter than fastener, spaced as indicated by panel manufacturer.

D. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

E. Apply panels with seams plumb and pattern aligned with adjoining panels.

F. Install panels with manufacturer's recommended gap for panel field and corner joints.

G. Drive fasteners to provide snug fit, and do not over-tighten.

H. Place trim on panel before fastening edges, as required.

I. Fill channels in trim with sealant before attaching to panel.

J. Install trim with adhesive and screws or nails, as required.

K. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

L. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION 06 83 16

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 07

THERMAL AND MOISTURE PROTECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 21 00 – THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Board insulation at perimeter foundation wall, underside of floor slabs, and exterior wall behind interior wall finish.

1.2 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.

1.3 SUBMITTALS

A. Product Data: Provide data on product characteristics and performance criteria.

B. Manufacturer's Installation Instructions: Include information on installation techniques.

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 Under Concrete Slabs: Expanded Polystyrene (EPS) board.

B. Insulation at Perimeter of Foundation: Expanded Polystyrene (EPS) board.

C. Insulation on Inside of Concrete Masonry Unit Exterior Walls: Expanded Polystyrene (EPS) board.

2.2 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578.

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. Board Size: 48 inch by 96 inch.

4. Board Thickness: As indicated on drawings.

5. Board Edges: Square.

6. ASTM C578 Classification: Type IV.

a. Compressive Strength: 25 psi (173 kPa), minimum.

b. Thermal Resistance: 5.0 (0.88) per 1-inch thickness at 75 degrees F mean temperature, minimum.

2.3 ACCESSORIES

A. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 - EXECUTION

3.1 GENERAL

A. Continuity of Insulation: Butt tightly against service penetrations, structural members, and all other intersecting object. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating thermal bridges and voids. Provide and verify continuity of insulative barrier throughout the building enclosure.

B. Apply insulation in two layers with staggered joints when total required thickness of insulation exceeds 2 inches. When using multiple layers of insulation, provide joints of each succeeding layer that are parallel and offset in both directions with respect to the layer below.

3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards horizontally on foundation perimeter.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards horizontally on walls.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Stagger horizontal and vertical joints.

3.4 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing concrete slab.

3.5 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 21 00

SECTION 07 21 26 – BLOWN INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Ceiling: Blown insulation pneumatically placed into joist spaces through access holes.

1.2 REFERENCE STANDARDS

A. ASTM C764 - Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation; 2019.

B. ASTM C1015 - Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation; 2017.

1.3 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and limitations.

B. Manufacturer's Installation Instructions: Indicate procedure for preparation and installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Applications: Provide blown insulation in ceiling as indicated on drawings.

B. Blown Insulation: ASTM C764, fiberglass type, nodulated for pour and bulk for pneumatic placement.

1. Thermal Transmittance (R-value): As indicated in drawings.

2.2 ACCESSORIES

A. Roof Ventilation Baffles: Prefabricated ventilation channels for placement under roof sheathing with baffles to prevent wind-washing and maintain clear space for attic ventilation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install insulation and ventilation baffle in accordance with ASTM C1015 and manufacturer's instructions.

B. Completely fill intended spaces leaving no gaps or voids.

3.2 CLEANING

A. Remove loose insulation residue.

END OF SECTION 07 21 26

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 25 00 – BUILDING ENVELOPE BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Building Envelope Barriers: Materials that form a system to stop passage of air, liquid water, or water vapor through all exterior building surfaces, including walls, roofs, and floors, transitions thereof, and all exterior openings and penetrations.

1. The specified properties of each building envelope barrier function collectively to prevent moisture accumulation in floor, wall, and roof assemblies. Only approved product substitutions are allowed.

2. Barrier materials may serve more than one of the functions defined below.

1.2 DEFINITIONS

A. Air Barrier: Airtight barrier made of material that is relatively air impermeable to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.

1. All air barrier materials have specified degrees of vapor permeability, and as such may or may not be classified as vapor retarders.

2. Some air barrier materials may also serve the purpose of a water-resistive barrier, as defined below.

B. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water.

1. Some water-resistive barrier materials may also be water vapor impermeable, to the degree specified.

C. Vapor Retarder: Airtight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.

1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

1.3 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. AATCC Test Method 127 - Water Resistance: Hydrostatic Pressure Test; 2014.

C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

F. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

G. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc; 2013.

H. ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials; ICC Evaluation Service, Inc; 2011.

I. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; ICC Evaluation Service, Inc; 2015.

J. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012.

1.4 SUBMITTALS

A. Product Data: Provide data on performance criteria for each barrier listed.

B. Manufacturer's Installation Instructions: Indicate preparation and installation methods.

C. Air Barrier Quality Control Reports.

1.5 QUALITY ASSURANCE

A. Air Barrier Quality Control Inspections: Contractor's Quality Control staff shall perform air barrier quality control inspections as described in this section.

1.6 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 - PRODUCTS

2.1 BE-4 - AIR BARRIER SHEET, MECHANICALLY FASTENED: AIR AND VAPOR IMPERMEABLE.

A. Location: Installed on the interior face of the exterior wall studs and roof trusses, and beneath the sub-slab insulation, as indicated in drawings.

B. General: Provide vapor retarder sheet, conforming to ASTM D4397 polyethylene film, clear.

C. Performance Criteria:

1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.

2. Water Vapor Permeance: 0.06 perms, maximum, when tested in accordance with ASTM E96/E96M, Procedure B.

3. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.

4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.

D. Seam and Perimeter Tape: As recommended by sheet manufacturer.

E. Seam and Perimeter Sealant: Acoustic Sealant

F. Material:

1. ASTM D4397 polyethylene film, clear.

2. Thickness: 6 mil, above grade.

3. Thickens: 10 mil, below grade.

2.2 BE-8 – ROOF UNDERLAYMENT, SELF-ADHERED: AIR, WATER-RESISTIVE AND VAPOR BARRIER.

A. Location: Installed as part of roofing system, as indicated in drawings.

B. General: Provide fully self-adhering, water-resistive, vapor retarding air barrier membrane. Self-adhering roof underlayment must exhibit no visible water leakage when tested in accordance with ASTM E331. Use regular or low temperature formulation depending on site conditions, within temperature ranges specified by manufacturer.

C. Performance Criteria:

1. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.

2. Water Vapor Permeance: 0.1 perms, maximum, when tested in accordance with ASTM E96/E96M, Procedure B.

3. Water Penetration Resistance around Nails: Pass, when tested in accordance with ASTM D1970/D1970M (modified).

4. Tensile Strength ASTM D5147: Not less than 50 lb/in (XMD).

5. Ultimate Elongation: Not more than 33%.

6. Puncture Resistance ASTM D5602: Not less than 80 lbs.

7. Cold Bending ASTM D5147: Not less than minus 45 degrees

8. Lap Adhesion (ASTM D1876 modified): Not less than 4.0 lbs per inch.

9. Peel Adhesion (<RID>ASTM D903</RID>): Not less than 5.0 lbs per inch.

10. Water Absorption (ASTM D5147): Not to exceed 0.12 percent by weight.

11. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.

12. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.

D. Seam and Perimeter Tape: As recommended by sheet manufacturer.

E. Substrate Primer: As recommended by sheet manufacturer.

F. Manufacturers:

1. GCP Applied Technologies: Grace Ice & Water Shield

2. Firestone Building Products, V-Force Vapor Barrier Membrane

3. Carlisle, WIP 300HT High-Temperature Protection Self-Adhering Roofing Underlayment

4. Or Equal.

2.3 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Air Barrier and Sealing Air Barrier to Adjacent Substrates: As indicated in drawings or as recommended by air barrier manufacturer.

B. Sealants, Tapes, and Accessories for Sealing Water-Resistive Barrier and Sealing Water-Resistive Barrier to Adjacent Substrates: As indicated in drawings or as recommended by Water-Resistive Barrier manufacturer.

C. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.

1. Composition: per Air Barrier manufacturer. Ensure chemical compatibility with all receiving materials.

2. Ultraviolet (UV) Light and Weathering Exposure: In accordance with ICC-ES AC 148.

3. Peel Adhesion: Pass, when tested in accordance with ASTM D 3330 Method F.

4. Cold Temperature Pliability: Pass, when tested in accordance with ASTM D 1970, AAMA 711.

5. Manufacturers:

a. As indicated by Air Barrier manufacturer.

D. Liquid Flashing: One part, fast curing, non-sag, elastomeric, gun grade, trowelable liquid flashing.

1. Composition: per material manufacturer. Ensure chemical compatibility.

2. Manufacturers:

a. As indicated by material manufacturer.

b. If air barrier manufacturer does not indicate suitable flashing products, submit product that meets the above criteria.

c. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.2 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives and primers in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water.

D. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.

E. Mechanically Fastened Sheets – Air and Vapor Barrier on Interior at Walls and Ceiling, and Floors (BE-4):

1. Seal entire perimeter to structure, window and door frames, and other penetrations.

2. Provide continuous bead of acoustical sealant across entire perimeter of each sheet.

   a. Lap joints:
      1) Lap sheets minimum of 12 inches.
      2) Locate laps at a framing member to prevent movement due to differential air pressures.
      3) Fasten one sheet to framing member then seal and tape overlapping sheet to first sheet.
      4) Apply continuous bead of sealant within 6 inches of lap.
      5) Apply vapor-resistive tape at edge of lap.

   b. Terminations:
      1) Apply continuous bead of sealant within 2 inches of sheet edge.
      2) Mechanically fasten edge of sheet to structural elements to prevent movement due to differential air pressures.
      3) Door and Windows openings: Lap with air barrier membrane from exterior side of wall assembly. Apply vapor-resistive tape at sheet edge.
      4) Bottom of wall: Extend sheet minimum 1-inch beyond wall-to-floor joint. Apply sealant to wall bottom plate, bottom track, or SIP edge.

3. Use only electrical boxes that have air/vapor seal rings. Seal sheet to box ring with acoustic sealant.

4. Seal penetrations, tears, and cuts with vapor-resistive tape, making airtight seal.

5. Seal at openings and penetrations as indicated in drawings, and as described in “Openings and Penetrations in Air- and Water-Resistive Barriers” section below.

F. Self-Adhered Sheets - Air and Water-Resistive Barrier on Exterior at Roof and Walls (BE-8):

1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.

2. Lap sheets shingle-fashion to shed water and seal laps airtight.

3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.

4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.

5. At wide joints, provide extra flexible membrane allowing joint movement.

6. Seal at openings and penetrations as indicated in drawings, and as described in “Openings and Penetrations in Air- and Water-Resistive Barriers” section below.

G. Door Openings in Air- and Water-Resistive Barriers:

1. Wrap interior air- and vapor barrier (BE-4) into rough opening, and seal to jamb and head stud framing.

2. Install flexible flashing over jamb and head of door opening, covering all areas of rough opening that will be concealed by door frame and finishes, extending at least 4 inches onto air- and vapor barrier (BE-4) at interior side of wall. At corners, use reinforcing strips or flexible sill flashing in accordance with manufacturer instructions.

3. At interior face of openings, insulate and seal gap between window/door frame and rough framing, using joint sealant over low-expansion foam insulation.

H. Penetrations in Air- and Water-Resistive Barriers:

1. At roof:

a. Form flexible flashing around penetrating item and seal to air barrier surface on both interior and exterior faces of assembly.

2. At wall:

a. Form flexible flashing around penetrating item and seal to air barrier surface on the interior of wall assembly.

b. Apply continuous bead of compatible sealant around penetrating item at the exterior face of wall assembly.

3.4 FIELD QUALITY CONTROL

A. Coordination of Air Barrier Inspections:

1. Provide Air Barrier inspection described below.

2. Notify Project Manager and General Contractor in writing of schedule for air barrier work and allow adequate time for General Contractor inspection.

3. Allow access to air barrier work areas and staging.

4. Do not cover air barrier work until inspected and accepted.

B. Take digital photographs of each portion of the installation prior to covering up.

C. Air Barrier Quality Control Inspections:

1. Conduct the following tests and inspections as applicable in the presence of the Project Manager during installation of the air barrier system, and submit quality control reports as indicated below.

a. Provide, at minimum, three inspections during construction.

b. Inspect to assure continuity of the air barrier system throughout the building enclosure and that all gaps are covered, the covering is structurally sound, and all penetrations are sealed allowing for no infiltration or exfiltration through the air barrier system.

c. Inspect to assure structural support of the air barrier system to withstand design air pressures.

d. Inspect and test to assure site conditions for application temperature, and dryness of substrates are within guidelines.

e. Inspect to assure substrate surfaces are properly primed if applicable and in accordance with manufacturer's instructions. Priming must extend at least 2 inches beyond the air barrier material to make it obvious that the primer was applied to the substrate before the air barrier material.

f. Inspect to assure laps in materials are as specified by this section or manufacturer instructions, shingled in the correct direction.

g. Inspect to assure that a roller has been used to enhance adhesion. Identify any defects such as fishmouths, wrinkles, areas of lost adhesion, and improper curing. Note the intended remedy for the deficiencies.

h. Inspect to assure that the correct materials are installed for compatibility.

i. Inspect to assure proper transitions for change in direction and materials.

j. Inspect to assure proper connection between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.

k. Inspected areas to include wall-to-floor interface; wall penetrations; window head, sill and jamb seal; door head and jamb seal; wall corners, wall-to-roof interface; parapets; roof penetrations, roof ridge; and other similar conditions.

3.5 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION 07 25 00

SECTION 07 41 13 – METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Architectural roofing system of preformed steel panels.

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); 2017a.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2019a.

C. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems; 2018.

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Storage and handling requirements and recommendations.

2. Installation methods.

3. Specimen warranty.

B. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.

1. Show work to be field-fabricated or field-assembled.

C. Manufacturer Qualification Statement: Provide documentation showing metal roof panel fabricator is accredited under IAS AC472.

D. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.6 WARRANTY

A. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of five years from Date of Substantial Completion.

B. Waterproofing Warranty: Provide manufacturer's warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water within specified warranty period of five years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL ROOF PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Metal Panels: Factory-formed panels with factory-applied finish.

1. Steel Panels:

a. Zinc-coated steel complying with ASTM A653/A653M; minimum G60 galvanizing.

b. Steel Thickness: Minimum 24 gage (0.024-inch).

2. Profile: Lapped seam, with integral sealant bead and exposed fastener system.

3. Texture: Smooth.

4. Width: Maximum panel coverage of 24 inches.

C. Metal Soffit Panels:

1. Profile: Style as indicated, with venting provided.

2. Material: Precoated steel sheet, 22 gage, 0.0299-inch minimum thickness.

3. Color: As indicated.

2.2 ATTACHMENT SYSTEM

A. Exposed System: Provide manufacturer's recommended stainless steel fasteners engineered to meet performance requirements and equipped with appropriate sealant separators to provide weathertight connections that will accommodate anticipated thermal movement.

2.3 FINISHES

A. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat aluminum coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009-inch; color and gloss to match sample.

2.4 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings and closure strips of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:

1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.

2. Concealed Sealant: Non-curing butyl sealant or tape sealant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.

1. Install roofing system with exposed fasteners prefinished to match panels.

2. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.

B. Accessories: Install all components required for a complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

C. Roof Panels: Install panels in strict accordance with manufacturer's instructions, minimizing transverse joints except at junction with penetrations.

3.2 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.3 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION 07 41 13

SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Fabricated sheet metal items, including flashings and counterflashings.

2. 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); 2017a.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2019a.

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. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.

1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.

2. Color: As indicated on drawings.

2.2 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2-inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.3 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer: Zinc chromate type.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

B. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

END OF SECTION 07 62 00

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Nonsag gunnable joint sealants.

1.2 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.

B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.

C. ASTM C834 - Standard Specification for Latex Sealants; 2017.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2018.

H. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.

I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2019.

J. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.

2. List of backing materials approved for use with the specific product.

3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.

4. Substrates the product should not be used on.

B. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

C. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

1.4 QUALITY ASSURANCE

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

B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.

1. Adhesion Testing: In accordance with ASTM C794.

2. Compatibility Testing: In accordance with ASTM C1087.

3. Allow sufficient time for testing to avoid delaying the work.

4. Deliver to manufacturer sufficient samples for testing.

5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

1.5 WARRANTY

A. Correct defective work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.

   a. Wall expansion and control joints.

   b. Joints between door, window, and other frames and adjacent construction.

   c. Joints between different exposed materials.

   d. Openings below ledge angles in masonry.

   e. Other joints indicated below.

2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.

   a. Joints between door, window, and other frames and adjacent construction.

   b. Other joints indicated below.

3. Do not seal the following types of joints.

   a. Intentional weepholes in masonry.

   b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.

   c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.

   d. Joints where installation of sealant is specified in another section.

   e. Joints between suspended panel ceilings/grid and walls.

B. Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.

2.2 NONSAG JOINT SEALANTS

A. Non-Staining 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. Non-Staining To Porous Stone: Non-staining 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. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.

5. Color: Match adjacent finished surfaces.

6. Service Temperature Range: Minus 20 to 180 degrees F.

B. 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.

C. Non-Curing Butyl Sealant: Solvent-based, single component, non-sag, non-skinning, non-hardening, non-bleeding; non-vapor-permeable; intended for fully concealed applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

3.2 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION 07 92 00

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 08

OPENINGS

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Non-fire-rated hollow metal doors and frames.

2. Thermally insulated hollow metal doors with thermally broken frames.

1.2 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2019a.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

I. ITS (DIR) - Directory of Listed Products; current edition.

J. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2007.

K. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.

L. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2017.

M. UL (DIR) - Online Certifications Directory; Current Edition.

N. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

C. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

D. Manufacturer's Qualification Statement.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.

2. Accessibility: Comply with ICC A117.1 and ADA Standards.

3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.

4. Door Edge Profile: Manufacturers standard for application indicated.

5. Typical Door Face Sheets: Flush.

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

2.2 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

a. Level 3 - Extra Heavy-duty.

b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.

c. Model 1 - Full Flush.

d. Door Face Metal Thickness: 16 gage, 0.053-inch, minimum.

e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.

2. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene.

3. Door Thickness: 1-3/4 inches, nominal.

2.3 HOLLOW METAL FRAMES

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

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Thermally broken, Knock-down type.

1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.

2. Frame Metal Thickness: 16 gage, 0.053-inch, minimum.

3. Insulation: Full depth of frame.

D. Door Frames: Knock-down type.

1. Frame Metal Thickness: 16 gage, 0.053-inch, minimum.

E. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

2.4 FINISHES

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

2.5 ACCESSORIES

A. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

3.2 TOLERANCES

A. Maximum Diagonal Distortion: 1/16-inch measured with straight edge, corner to corner.

3.3 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION 08 11 13

SECTION 08 36 13 – SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Overhead sectional doors, manually operated.

2. Operating hardware and supports.

1.2 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2019a.

B. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

C. DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors; 2011.

1.3 SUBMITTALS

A. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

B. Product Data: Show component construction, anchorage method, and hardware.

C. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.

D. Manufacturer's Qualification Statement.

E. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

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

1.5 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STEEL DOORS

A. Steel Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.

1. Basis of Design: Thermacore door 591 Series by Overhead Door Corporation.

2. Door Nominal Thickness: 1-5/8 inches thick.

3. Air Leakage Rate: Less than 0.40 cfm/sf when tested in accordance with ASTM E283 at test pressure difference of 1.57 psf.

4. Exterior Finish: Factory finished with polyester baked enamel; color as selected from manufacturers standard line.

5. Interior Finish: Factory finished with acrylic baked enamel; color as selected from manufacturers standard line.

6. Manual Operation: Chain hoist.

B. Door Panels: Steel construction; outer steel sheet of 20 gage, 0.0359-inch minimum thickness, flush profile; inner steel sheet of 20 gage, 0.0359-inch minimum thickness, flat profile; core reinforcement sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; polyurethane insulation.

2.2 COMPONENTS

A. Track: Rolled galvanized steel, 0.090-inch minimum thickness; 2-inch wide, continuous one piece per side; galvanized steel mounting brackets 1/4-inch thick.

B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.

C. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables.

1. For Manual Operation: Requiring maximum exertion of 25 lbs force to open.

D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.

E. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.

F. Head Weatherstripping: EPDM rubber seal, one piece full length.

G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

H. Lock: Inside center mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior and exterior handle.

I. Lock Cylinders: Keyed alike.

2.3 MATERIALS

A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G60/Z180 coating, plain surface.

B. Insulation: Foamed-in-place polyurethane, bonded to facing.

1. R-value of 14.86.

C. Metal Primer Paint: Zinc molybdate type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Anchor assembly to wall construction and building framing without distortion or stress.

C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

D. Fit and align door assembly including hardware.

3.2 TOLERANCES

A. Maximum Variation from Plumb: 1/16-inch.

B. Maximum Variation from Level: 1/16-inch.

C. Longitudinal or Diagonal Warp: Plus or minus 1/8-inch from 10-foot straight edge.

D. Maintain dimensional tolerances and alignment with adjacent work.

3.3 ADJUSTING

A. Adjust door assembly for smooth operation and full contact with weatherstripping.

3.4 CLEANING

A. Clean doors and frames.

B. Remove temporary labels and visible markings.

END OF SECTION 08 36 13

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.

1. Door hardware for steel (hollow metal) doors.
2. Door hardware for other doors indicated.
3. Keyed cylinders as indicated.

B. Related Sections:

1. Division 6: Rough Carpentry.
2. Division 8: Hollow Metal Doors and Frames.

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.

1. Builders Hardware Manufacturing Association (BHMA)
2. NFPA 101 Life Safety Code
3. ANSI-A156.xx- Various Performance Standards for Finish Hardware
4. UL10C – Positive Pressure Fire Test of Door Assemblies
5. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
6. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
7. ICC – International Building Code

D. Intent of Hardware Groups

1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

E. Alternates

1. Refer to Division 1 for Alternates and procedures.

1.2 SUBSTITUTIONS

A. Comply with Division 1.

1.3 SUBMITTALS

A. Comply with Division 1.

B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Submit 6 copies of catalog cuts with hardware schedule.
4. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2

D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.

1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Manufacturer, product name, and catalog number.
4. Function, type, and style.
5. Size and finish of each item.
6. Mounting heights.
7. Explanation of abbreviations and symbols used within schedule.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

F. Samples: (Not required)

G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.

1. Operating and maintenance manuals: Submit 3 sets containing the following.

a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Name, address, and phone number of local representative for each manufacturer.
d. Parts list for each product.

2. Copy of final hardware schedule, edited to reflect, "As installed".
3. Copy of final keying schedule
4. As installed “Wiring Diagrams” for each piece of hardware connected to power, both low voltage and 110 volts.
5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.

1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.

3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.

    a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
    b. Hardware Schedule shall be prepared and signed by an AHC.

4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.

    a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
    b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.

6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY

A. Refer to Conditions of the Contract.

B. Manufacturer's Warranty:

1. Closers: Twentry Five years
2. Locksets & Cylinders: Life of Bldg.
3. All other Hardware: Two years.

1.8 OWNER'S INSTRUCTION

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.

1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hinges: Shall be Five Knuckle Ball bearing hinges

1. Template screw hole locations
2. Bearings are to be fully hardened.
3. Bearing shell is to be consistent shape with barrel.
4. Minimum of 2 permanently lubricated non-detachable bearings on standard weight hinge and 4 permanently lubricated bearing on heavy weight hinges.
5. Equip with easily seated, non-rising pins.
6. Non Removable Pin screws shall be slotted stainless steel screws.
7. Hinges shall be full polished, front, back and barrel.
8. Hinge pin is to be fully plated.
9. Bearing assembly is to be installed after plating.
10. Sufficient size to allow 180-degree swing of door
11. Furnish five knuckles with flush ball bearings
12. Provide hinge type as listed in schedule.
13. Furnish 3 hinges per leaf to 7-foot 6-inch height. Add one for each additional 30 inches in height or fraction thereof.
14. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
15. UL10C listed for Fire rated doors.

B. Mortise Type Locks and Latches:

1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C.
2. Furnish UL or recognized independent laboratory certified mechanical operational testing to 4 million cycles minimum.
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Fit ANSI A115.1 door preparation.
5. Functions and design as indicated in the hardware groups.
6. Solid, one-piece, 3/4-inch (19mm) throw, anti-friction latchbolt made of self-lubricating stainless steel.
7. Deadbolt functions shall have 1 inch (25mm) throw bolt made of hardened stainless steel.
8. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8-inch (9.5mm) when fully extended.
9. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated.
10. Provide sufficient curved strike lip to protect door trim.
11. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable.
12. Lock shall have self-aligning, thru-bolted trim.
13. Levers to operate a roller bearing spindle hub mechanism.
14. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
15. Spindle to be designed to prevent forced entry from attacking of lever.
16. Provide locksets with 7-pin removable and interchangeable core cylinders.
17. Each lever to have independent spring mechanism controlling it.
18. Core face must be the same finish as the lockset.

C. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1.
2. UL10C certified.
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Closer shall have extra-duty arms and knuckles.
5. Conform to ANSI 117.1
6. Maximum 2 7/16 inch case projection with non-ferrous cover.
7. Separate adjusting valves for closing and latching speed, and backcheck.
8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions.
9. Full rack and pinion type closer with 1-1/2 inch minimum bore.
10. Mount closers on non-public side of door, unless otherwise noted in specification.
11. Closers shall be non-handed, non-sized and multi-sized.

D. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.

1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered.

E. Over Head Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.

1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
2. Surface overhead stops shall be heavy duty bronze or stainless steel.

F. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

G. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.

1. Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone).
2. UL10C Positive Pressure rated seal set when required.

H. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.

1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
2. UL10C Positive Pressure rated seal set when required.

I. Thresholds: Thresholds shall be aluminum beveled type with maximum height of 1/2-inch for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

J. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.

1. Recommended Locations for Builder’s Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).

2. Recommended locations for Architectural Hardware for flush wood doors (DHI).

3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.

1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Check and adjust closers to ensure proper operation.

2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

a. Verify levers are free from binding.
b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 SCHEDULE OF FINISH HARDWARE

Manufacturer List

Code	Name
BE	Best Access Systems
DH	Design Hardware
DM	Dorma Door Controls
NA	National Guard
ST	Stanley
TR	Trimco

Hardware Sets

SET #1

Doors: 101A, 102A, 103A

3 Hinges	FBB199 4 1/2 X 4 1/2 NRP	US32D	ST
1 Lockset	5021B-WL-26D-4	626	DM
1 Closer	8916 SPA	689	DM
1 Overhead Stop	912 S	626	DM
1 Gasketing	127 NA 1 x 36" 2 x 84"		NA
1 Drip Cap	16 A - 4" ODW		NA
1 Door Sweep	200 NA		NA
1 Threshold	8426 36"	AL	NA

SET #2

Doors: 102B

3 Hinges	FBB179 4 1/2 X 4 1/2	US26D	ST
1 Passage Set	45H-0N15H	630	BE
1 Closer	8916-AFP	689	DM
1 Convex Wall Stop	WS-CV	US32D	DH
3 Door Silencers	1229A	GREY	TR

DIVISION 09

FINISHES

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Metal partition framing.

2. Framing accessories.

1.2 REFERENCE STANDARDS

A. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.

B. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2018.

1.3 SUBMITTALS

A. Product Data: Provide data describing framing member materials and finish and product criteria.

B. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

PART 2 - PRODUCTS

2.1 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; 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/240 at 5 psf.

1. Studs: C shaped with knurled or embossed faces.

2. Runners: U shaped, sized to match studs.

B. 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.

PART 3 - EXECUTION

3.1 INSTALLATION OF STUD FRAMING

A. Extend partition framing to structure where indicated and to ceiling in other locations.

B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

C. Align and secure top and bottom runners at 24 inches on center.

D. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

E. Align stud web openings horizontally.

F. Secure studs to tracks using crimping method. Do not weld.

G. Fabricate corners using a minimum of three studs.

H. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.

I. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

3.2 TOLERANCES

A. Maximum Variation From True Position: 1/8-inch in 10 feet.

END OF SECTION 09 22 16

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Surface preparation.

2. Field application of paints.

3. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

4. Do Not Paint or Finish the Following Items:

a. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.

b. Items indicated to receive other finishes.

c. Items indicated to remain unfinished.

d. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.

e. Floors, unless specifically indicated.

f. Glass.

g. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.3 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").

2. MPI product number (e.g. MPI #47).

3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.

1. Where sheen is specified, submit samples in only that sheen.

C. Manufacturer's Instructions: Indicate special surface preparation procedures.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Supply each paint material in quantity required to complete entire project's work from a single production run.

3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:

1. Provide paints and finishes that comply with the most stringent requirements specified in the following:

a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Colors: As indicated on drawings.

2.2 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed metal.

1. Two top coats and one coat primer.

2. Top Coat(s): Exterior Light Industrial Coating, Water Based; MPI #161, 163, or 164.

2.3 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

2.4 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.2 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.3 CLEANING

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

3.4 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.5 COLOR SCHEDULE

A. Colors to be selected by architect from standard color palette.

END OF SECTION 09 91 13

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 09 92 00 PIPE PAINTING

PART 1 - GENERAL

1.1 REFERENCES

A. American National Standards Institute (ANSI):
   1. Standard Colors for Color Identification and Coding.
   2. A13.1, Scheme for the Identification of Piping Systems.

B. American Water Works Association (AWWA):
   1. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied.
   2. C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
   3. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   4. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.

C. NSF International
   1. NSF: 61 Drinking Water System Components - Health Effects.

D. NACE International
   1. RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

E. The Society for Protective Coatings (SSPC):
   1. QP1, Standard Procedure for Evaluating Qualifications of Painting Contractors (Field Application to Complex Structures).
   2. QP2, Standard Procedure for Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint.
   3. SP 1, Solvent Cleaning.
   4. SP 2, Hand Tool Cleaning.
   5. SP 3, Power Tool Cleaning.
   6. SP 5, Joint Surface Preparation Standard White Metal Blast Cleaning.
   7. SP 6, Joint Surface Preparation Standard Commercial Blast Cleaning.
   8. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
   9. SP 10, Joint Surface Preparation Standard Near-White Blast Cleaning.
   10. SP 11, Power Tool Cleaning to Bare Metal.
   11. SP 12, Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating.
   12. SP 13, Surface Preparation of Concrete.
   13. PA 1, Shop, Field, and Maintenance Painting.
   14. PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
   15. PA 3, Guide to Safety in Paint Applications.

F. Ductile Iron Pipe Research Association (DIPRA)
   1. Surface Preparation Specifications.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

A. Shop Drawings:
1. Data Sheets:
   a. For each paint system, furnish a Paint System Data Sheet (PSDS), the manufacturer's technical data sheets, and paint colors available (where applicable) for each product used in paint system. The PSDS form is appended to the end of this section.
   b. Technical and performance information that demonstrate compliance with Specification.
   c. Submit required information on a system-by-system basis.
   d. Furnish copies of paint system submittals to the coating applicator.
   e. Indiscriminate submittal of manufacturer's literature only is not acceptable.
2. Detailed chemical and gradation analysis for each proposed abrasive material.

B. Samples:
1. Proposed Abrasive Materials: Minimum 5-pound sample for each type.
2. Reference Panel:
   a. Surface Preparation:
      1) Prior to start of surface preparation, furnish a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared to specified requirements.
      2) Provide panel representative of the steel used; prevent deterioration of surface quality.
      3) Upon approval by ENGINEER, panel to be reference source for inspection.
   b. Paint:
      1) Unless otherwise specified, before painting work is started, prepare minimum 8- by 10-inch sample with type of paint and application specified on similar substrate to which paint is to be applied.
      2) Furnish additional samples as required until colors, finishes, and textures are approved.
      3) Approved samples to be the quality standard for final finishes.

C. Information Submittals:
1. Applicator’s Qualification: List of references substantiating experience.

2. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
3. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer’s written confirmation that materials are compatible.
4. Manufacturer's written instructions and special details for applying each type of paint.
5. Manufacturer’s written verification that submitted material is suitable for the intended use.

1.4 QUALITY ASSURANCE

A. Qualifications:
1. Applicator: Minimum 5 years’ experience in application of specified products.

B. Regulatory Requirements:
2. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
3. Perform surface preparation and painting in accordance with recommendations of the following:
   a. Paint manufacturer's instructions.
   b. SSPC PA 3, Guide to Safety in Paint Applications.
   c. Federal, state, and local agencies having jurisdiction.

C. Mockup:
4. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
5. After ENGINEER approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Shipping:
6. Where precoated items are to be shipped to the site, protect coating from damage. Batten coated items to prevent abrasion.
7. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:
8. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
9. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:
10. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.

11. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

B. Existing Coatings:
12. Perform tests as required to verify existing paint types and compatibility with new painting.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.

B. Minimum of 5 years' verifiable experience in manufacture of specified product.

2.2 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.3 PAINT MATERIALS

A. General:
13. Manufacturer's highest quality products suitable for intended service.
14. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
15. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

Product	Definition
Acrylic Latex	Single-component, finish as required
Acrylic Latex (Flat)	Flat latex
Acrylic Sealer	Clear acrylic
Alkyd (Semigloss)	Semigloss alkyd
Alkyd Enamel	Optimum quality, gloss or semigloss finish as required, medium long oil
Alkyd Wood Primer	Flat alkyd
Bituminous Paint	Single-component, coal-tar pitch based
Block Filler	Primer-sealer designed for rough masonry surfaces, 100% acrylic emulsion
Coal-Tar Epoxy	Amine, polyamide, or phenolic epoxy type 70% volume solids minimum, suitable for immersion service
Elastomeric	100% solids, plural component, spray applied, high build,

Polyurethane	elastomeric polyurethane coating, suitable for the intended service
Epoxy Primer Ferrous Metal	Anticorrosive, converted epoxy primer containing rust-inhibitive pigments
Epoxy Primer Other	Epoxy primer, high-build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated
High Build Epoxy	Polyamide or polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat
Inorganic Zinc Primer	Solvent or water based, having 85% metallic zinc content in the dry film; follow manufacturer's recommendation for topcoating
Latex Primer Sealer	Waterborne vinyl acrylic primer/sealer for interior gypsum board and plaster. Capable of providing uniform seal and suitable for use with specified finish coats
Polyamide Epoxy, High Solids	80% volume solids, minimum, suitable for immersion service
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish
Rust-Inhibitive Primer	Single-package steel primers with anticorrosive pigment loading

2.4 MIXING

A. Multiple-Component Coatings:
1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at site.

2.5 SHOP FINISHES

A. Shop Blast Cleaning: Reference paragraph Shop Coating Requirements, this section.

B. Surface Preparation: Provide ENGINEER minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:
1. When required by equipment Specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
2. Where manufacturer’s standard coating is not suitable for intended service condition, ENGINEER may approve use of a tie-coat to be used between manufacturer’s standard

coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide ENGINEER minimum 7 days' advance notice to start of field surface preparation work and coating application work.

B. Perform the Work only in presence of ENGINEER, unless ENGINEER grants prior approval to perform the Work in ENGINEER's absence.

C. Schedule inspection with ENGINEER in advance for cleaned surfaces and all coats prior to succeeding coat.

3.2 EXAMINATION

A. Factory Finished Items:
   1. Schedule inspection with ENGINEER before repairing damaged factory-finished items delivered to site.
   2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.3 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect all surfaces adjacent to, or downwind of Work area from overspray.

3.4 SURFACE PREPARATION

A. Field Abrasive Blasting:
   1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
   2. Refer to coating systems for degree of abrasive blasting required.
   3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.

B. Metal Surface Preparation:
   1. Where indicated, meet requirements of SSPC Specifications summarized below:
      a. SP1, Solvent Cleaning: Removal of all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
      b. SP2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
      c. SP3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.
      d. SP5, White metal Blast Cleaning: Removal of all visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.
      e. SP6, Commercial Blast Cleaning: Removal of all visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
      f. SP7, Brush-Off Blast Cleaning: Removal of all visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.
      g. SP10, Near-White Blast Cleaning: Removal of all visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
      h. SP11, Power Tool Cleaning to Bare Metal: Removal of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.
      i. SP12, Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating: Surface preparation using high- and ultrahigh-pressure water jetting to achieve specified surface cleanliness condition. Surface cleanliness conditions are defined in SSPC SP12 and are designated WJ-1 through WJ-4 for visual surface preparation definitions, and SC-1 through SC-3 for nonvisual surface preparation definitions.
   2. The words "solvent cleaning," "hand tool cleaning," "wire brushing," and "blast cleaning," or similar words of equal intent in these Specifications or in paint manufacturer's specification refer to the applicable SSPC Specification.
   3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.

4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.
5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
7. Welds and Adjacent Areas:
   a. Prepare such that there is:
      1) No undercutting or reverse ridges on weld bead.
      2) No weld spatter on or adjacent to weld or any area to be painted.
      3) No sharp peaks or ridges along weld bead.
   b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
8. Preblast Cleaning Requirements:
   a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
   b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
   c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
9. Blast Cleaning Requirements:
   a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
   b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
   c. Use only dry blast cleaning methods.
   d. Do not reuse abrasive, except for designed recyclable systems.
   e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
10. Post-Blast Cleaning and Other Cleaning Requirements:
   a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
   b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

C. Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation:
   1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.
   2. Remove oil and grease by wiping or scrubbing surface with suitable solvent, rag, and brush. Use clean solvent and clean rag for final wiping to avoid contaminating surface.
   3. Obtain and follow coating manufacturer’s recommendations for additional preparation that may be required.

D. Existing Painted Surfaces to be Repainted Surface Preparation:
   1. Detergent wash and freshwater rinse.
   2. Clean loose, abraded, or damaged coatings to substrate by Hand or Power Tool, SP 2 or SP 3.
   3. Feather surrounding intact coating.
   4. Apply one spot coat of specified primer to bare areas, overlapping prepared existing coating.

5. Apply one full finish coat of specified primer to entire surface.
6. If an aged, plural-component material is to be topcoated, contact coating manufacturer for additional surface preparation requirements.
7. For ductile iron pipe with asphaltic varnish finish not specified to be abrasive blasted, apply coat of tar stop prior to application of cosmetic finish coat.
8. Application of Cosmetic Coat:
   a. It is assumed that existing coatings have oxidized sufficiently to prevent lifting or peeling when overcoated with paints specified.
   b. Check compatibility by application to a small area prior to starting painting.
   c. If lifting or other problems occur, request disposition from ENGINEER.
9. Perform blasting as required to restore damaged surfaces. Materials, equipment, procedures shall meet requirements of Steel Structures Painting Council.

3.5 SURFACE CLEANING

A. Brush-off Blast Cleaning:
   1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7, Brush-off Blast Cleaning.
   2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
   3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
   4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
   5. ENGINEER will approve acceptable trial blast cleaned area and will use area as a representative sample of surface preparation.
   6. Repair or replace surface damaged by blast cleaning.

B. Acid Etching:
   1. After precleaning, spread the following solution by brush or plastic sprinkling can: 1 part commercial muriatic acid reduced by 2 parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HCl.
   2. Application:
      a. Application Rate: Approximately 2 gallons per 100 square feet.
      b. Work acid solution into surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained.
      c. Acid will react vigorously for a few minutes, during which time brushing shall be continued.
      d. After bubbling subsides (10 minutes), hose down remaining slurry with high pressure clean water.
      e. Rinse immediately to avoid formation on the surface of salts that are difficult to remove.
      f. Thoroughly rinse to remove any residual acid surface condition that may impair adhesion.
   3. Ensure surface is completely dry before application of coating.
   4. Apply acid etching to obtain a “grit sandpaper” surface profile. If not, repeat treatment.

C. Solvent Cleaning:
   1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning

compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action.

2. Meets requirements of SSPC SP 1.

1.02 APPLICATION

A. General:

1. The intention of these Specifications is for existing and new, interior and exterior masonry, concrete, and metal surfaces to be painted.
2. Existing building exterior surfaces to be painted, are defined on the architectural drawings. The existing outdoor fuel oil storage tank shall be painted the same color as the building "field" color, ICI700, Burmese Beige, except the paint system shall be System No. 5.
3. Existing building interior surfaces to be painted shall be all surfaces which are contiguous with, and adjacent to, surfaces which are currently painted and where the surface has been exposed due to demolition work, such as removal of existing pump shaft steady bearing support beams, electrical and control panels, and removal of existing electrolyte piping and pipe supports.
4. New work shall be painted, color matched to existing surfaces the work connects to. Painting shall be applied not less than 6 inches onto cleaned and properly prepared existing surfaces.
5. Coatings shall be applied to internal nozzle bores and flange gasket sealing surfaces, unless otherwise specified.
6. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.
7. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
8. Sand wood lightly between coats to achieve required finish.
9. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
10. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
11. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
12. Keep paint materials sealed when not in use.
13. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Galvanized Metal, Copper, and Nonferrous Metal Alloys:

1. Concealed galvanized, copper, and nonferrous metal alloy surfaces (behind building panels or walls) do not require painting, unless specifically indicated herein.
2. Prepare surface and apply primer in accordance with System No. 10 specification.
3. Apply intermediate and finish coats of the coating system appropriate for the exposure.

C. Porous Surfaces, Such As Concrete and Masonry:

1. Filler/Surfacer: Use coating manufacturer's recommended product to fill air holes, bug holes, and other surface voids or defects.
2. Prime Coat: May be thinned to provide maximum penetration and adhesion.
   a. Type and Amount of Thinning: Determined by paint manufacturer and dependent on surface density and type of coating.

3. Surface Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of coating.

D. Film Thickness and Coverage:
1. Number of Coats:
   a. Minimum required without regard to coating thickness.
   b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
   a. Do not exceed coating manufacturer's recommendations.
   b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
   a. Perform with properly calibrated instruments.
   b. Recoat and repair as necessary for compliance with Specification.
   c. All coats are subject to inspection by ENGINEER and coating manufacturer's representative.
4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.6 PROTECTIVE COATINGS SYSTEMS

A. Inner Lining – Domestic Process Water:

Surface Prep.	Paint Material	Min. Coats, Cover
SP5, White Metal Blast Cleaning	Epoxy Primer – Tnemec Series N69 High Build Epoxoline II, Polyamidoamine Epoxy	1 coat, 3-4 MDFT
	Devoe 233H to AWWA C210 Specifications	2 coats, 10-12 MDFT

B. Exposed Metal – Mildly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP10, Near-White Blast Cleaning	Epoxy Primer – Ferrous Metal	1 coat, 2.5 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

C. Exposed Metal – Atmospheric:

Surface Prep.	Paint Material	Min. Coats, Cover
SP6, Commercial Blast Cleaning	Rust-Inhibitive Primer	1 coat, 2 MDFT
	Alkyd Enamel	2 coats, 4 MDFT

D. Galvanized Metal, Copper, and Nonferrous Metal Alloy Conditioning:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation Section	Epoxy Primer – Other	As recommended by the coating manufacturer Remaining coats as required for exposure

3.7 FIELD QUALITY CONTROL

A. Testing Equipment:
1. Provide magnetic type dry film thickness gauge to test coating thickness specified in mils, as manufactured by Nordson Corp., Anaheim, CA, Mikrotest.
2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit to be as recommended by coating manufacturer.

B. Testing:
1. Thickness and Continuity Testing:
   a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
   b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE RP0188.
   c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE RP0188.
   d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by ENGINEER.

C. Inspection: Leave staging and lighting in place until ENGINEER has inspected surface or coating. Replace staging removed prior to approval by ENGINEER. Provide additional staging and lighting as requested by ENGINEER.

D. Unsatisfactory Application:
1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:
1. Feather edges and repair in accordance with recommendations of paint manufacturer.

2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.8 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from site or destroy in a legal manner.

C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.9 APPLICATION SCHEDULE

A. Surfaces Not Requiring Painting: Unless otherwise stated or shown below or in other sections, the following areas or items will not require painting or coating:
   1. Reinforcing steel.
   2. Nonferrous and corrosion-resistant ferrous alloys such as aluminum, chromium plate, atmospherically exposed weathering steel, and stainless steel, except where:
      a. Required for electrical insulation between dissimilar metals.
      b. Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
      c. Color coding of equipment and piping is required.
   3. Nonmetallic materials such as glass, wood, and porcelain, except as required for architectural painting or color coding.
   4. Prefinished electrical and architectural items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches (if prefinished in OSHA yellow), building louvers, and wall panels; color coding of equipment is required.
   5. Items specified to be galvanized after fabrication, unless specified elsewhere or subject to immersion.
   6. Insulated piping and insulated piping with jacket will require prime coat only, except as required for architectural painting or color coding.
   7. Fiberglass reinforced plastic (FRP) surfaces with an integral ultra-violet resistant colored gel coat do not require painting, provided the color is as selected.

B. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from ENGINEER before starting work in question.

C. Inner Lining – Domestic Process Water: Use on the following items or areas:
   1. Interior surfaces of steel piping, nozzles and gasket surfaces of flanged pipe joints.

D. Exposed Metal – Mildly Corrosive: Use on the following items or areas:
   1. Exposed metal surfaces, located inside or outside of structures and exposed to weather and all new piping.

E. Exposed Metal – Atmospheric: Use on the following items or areas:
   1. Exposed metal surfaces, located inside or outside of structures or exposed to weather, including metal doors and frames, vents, exterior metal ductwork, flashing, sheet metalwork and miscellaneous architectural metal trim, and the following specific surfaces:
      a. Inside duct stack heads behind diffusers, registers, and grilles with flat black.
      b. Electrical, instrumentation and control systems exposed enclosures.
   2. Apply surface preparation and primer to surfaces prior to installation. Finish coats need only be applied to surfaces exposed after completion of construction.

F. Galvanized Metal, Copper, and Nonferrous Metal Alloy Conditioning: Use on the following items or areas:
   1. Galvanized, copper and nonferrous metal alloy surfaces requiring painting.
   2. After application of System No. 10, apply finish coats as required for exposure.

G. Metal Trim and Structural Steel: Use on the following items or areas:
   1. Steel fabrications.

H. Masonry, Flat: Use on the following items or areas:
   1. Masonry wall infill.

3.10 SUPPLEMENTS

A. The supplements listed below, following "END OF SECTION," are a part of this Specification:
   1. Paint System Data Sheet (PSDS).

END OF SECTION 09 92 00

PAINT SYSTEM DATA SHEET

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

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

Provide manufacturer's recommendations for the following parameters at temperature /relative humidity:

Temperature(F)/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendations for:

Mixing Ratio:_____
Maximum Permissible Thinning:_____
Ambient Temperature Limitations: min.:_____ max.:_____
Surface Temperature Limitations: min.:_____ max.:_____
Surface Profile Requirements: min.:_____ max.:_____

END OF SECTION 09 92 00

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 11

EQUIPMENT

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11 93 20 - CHEMICAL METERING PUMPS & ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Chemical metering pumps
   2. System accessories.

1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. Underwriters Laboratories, Inc. (UL): 508, Standard for Industrial Control Equipment

B. Secure and coordinate entire system including but not necessarily limited to metering pumps, electric equipment, controls, hardware, valving, and piping through the metering pump manufacturer.

1.3 SYSTEM DESCRIPTION

A. System shall be supplied through a single source and include all components specified herein.

1.4 SUBMITTALS

A. Submittals shall be in accordance with Division 1.

B. Product Data:
   1. Provide catalog data for all materials, and equipment.
   2. Indicate pump type, capacity, power requirements, and affected adjacent construction.
   3. Provide electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions.

1.5 OPERATION AND MAINTENANCE DATA

A. Reference Division 1 for additional requirements.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

C. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

PART 2 - PRODUCTS

2.1 METERING PUMPS

A. Acceptable Manufacturers
   1. Subject to compliance with the Contract Documents the following manufacturers are acceptable:
      a. Stenner 85MPH17
      b. Or Owner Approved Equal.

B. Materials:
   1. Pump housing: PVDF.
   2. Pump Head: PVDF.
   3. Diaphragm: PTFE
   4. Ball valve: Ceramic.
   5. Seals: PTFE

C. Pump Performance and Design Requirements:
   1. Capacity:
      a. 2 Gallons per hour of sodium hypochlorite with a specific gravity of 1.22 to 1.25 at 68°F with a discharge pressure of 360 psig.
      b. At minimum output signal: - 1/36000 of maximum output capacity.
      c. Maximum discharge stroke frequency in strokes per minute: 200.
      d. Adjustable suction and discharge stroke duration.

D. Pump Fabrication:
   1. Pump:
      a. Spring Loaded Ball-check inlet and outlet valves.
      b. Moving parts totally enclosed and self-lubricating.
      c. Drain connection in pump discharge head.
      d. Complete external control with 1000:1 minimum manual stroke adjustment, adjustable while operating.
      e. Capable of operating dry without damage to any component.
      f. Repeatable accuracy: 2 percent of maximum output or better.
      g. Nameplate with chemical, capacity (gph) and pressure (psi) ratings.
      h. Dosing monitor.
   2. Drive:
      a. Motors: 115 VAC.
      b. Internal solenoid drive.
      c. 3-prong 115 VAC plug.

E. Controls
   1. Output control:
      a. Manual through push buttons on pump control panel
      b. Automatically by 4-20mA external signal.
   2. Control panel shall have digital readout display in gallons per hour.
   3. Remote ON/OFF control.
   4. Remote FAIL alarm.
   5. Communication between Pump and plant PLC system: 4-20mA.

6. Capable of venting gas/air build-up for up to 30 seconds without an alarm. If pump does not begin pumping failure signal will be activated.

F. Accessories
1. Provide the following for each metering pump:
a. One pressure relief valve with 1/2 IN FPT connections sized for the flow rate of the pump. Pressure relief range shall be 50 psig.
b. One backpressure/anti-siphon valve with a setting range of 40 psig with 1/2 IN FPT connections.
c. 1000 cc calibration chamber 1/2 IN diaphragm valve
d. Mounting stand to include the following components factory or shop mounted ready for installation.
1) Mounting panel: 1/2 IN PVC or FRP.
2) Chemical pumps.
3) Calibration column.
4) Pressure relief valve.
5) Back pressure valves
e. Discharge and suction hose kits.
f. Diaphragm isolation valves.

G. Maintenance Parts
1. Complete spare pump
2. Provide one set of spare parts consisting of:
a. Pump Head assembly
b. Suction and discharge valve assemblies.

2.2 HYPOCHLORITE SOLUTION TANK

A. Acceptable Manufacturers
1. Subject to compliance with the Contract Documents the following manufacturers are acceptable:
a. U.S. Plastic Corp.
b. Or equal.

B. High Density Polyethylene Tapered Cylindrical tank: 30 gallon capacity translucent tank with cover and molded in calibrations. Provide PVC bulkhead fittings as shown for hypochlorite solution draw.

2.3 HYPOCHLORITE SOLUTION TRANSFER PUMP

A. Acceptable Manufacturers
1. Subject to compliance with the Contract Documents the following manufacturers are acceptable:
a. Finish Thompson Inc. (FTI)
b. Or equal.

B. Portable pump capable of insertion into a standard 55 gallon drum with detachable motor head and 10 feet of flexible reinforced PVC discharge hose.

1. Pump shall be 40 inch long PVDF construction with 625 alloy shaft and PTFE bearings and shall be specifically designed for sodium hypochlorite use. 15 GPM delivery capacity at 10 feet TDH.
2. Pump motor shall have quick connect feature to pump without tools. Double wall housing, continuous duty, variable speed from 3500-10000 RPM. 1/2 HP 115V AC, CSA listed, with 12 foot cord and plug with integral circuit breaker.
3. Provide a wall mount bracket for storage of the pump when not in use in a delivery drum.

2.4 HYPOCHLORITE SOLUTION

A. Provide 55 gallons of hypochlorite solution (12% nominal active chlorine) in a standard shipping drum.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Install per manufacturer's installation instructions.

B. Coordinate manufacturer's field services to provide a complete workable system.

C. Provide startup of chemical metering systems.

END OF SECTION 11 93 20

DIVISION 14

BRIDGE CRANE

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 14 47 00 – BRIDGE CRANE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: All crane components to assemble and operate a 2,500 pound overhead, chain operated, manual traveling crane, providing clearance for the overhead door and lighting installations.

1.2 DEFINITIONS

A. Crane Bridge: That part of an overhead crane system consisting of girder(s), end trucks, end ties, walkway, and drive mechanism which carries the trolley(s) and travels along the runway rails parallel to the runway.

B. Crane Runway: The track system along which the crane operates horizontally, including track hangar rods, track connection devices, and runway structural supports.

C. Dead Loads: The loads on a structure which remain in a fixed position relative to the structure.

D. Girder: The principal horizontal beam of the crane bridge. It is supported by the crane end trucks. Normally the crane trolley mounted hoist is suspended from the girder below the crane.

E. Live Load: A load which moves relative to the structure under consideration.

F. Rated Load: For the purpose of this specification the rated load is defined as the maximum working load suspended under the load hook. Load block and wire ropes, conforming to ASTM A 1023/A 1023M and ASTM A 931 are not included in the rated load.

G. Standard Commercial Cataloged Product: A product which is currently being sold, or previously has been sold, in substantial quantities to the general public, industry or Government in the course of normal business operations. Models, samples, prototypes or experimental units do not meet this definition. The term "cataloged" as specified in this section is defined as "appearing on the manufacturer's published product data sheets. These data sheets should have been published or copyrighted prior to the issue date of this solicitation bearing a document identification number or bulletin number.

H. Top Running Crane: A manually operated traveling crane that runs on rails on top of support beams. The load is supported by the entire cross-section of the beam.

I. Trolley Mounted Hoist: A combined unit consisting of a wheeled trolley that provides horizontal motion along the bridge girder, and a hoist suspended from the trolley, which provides lifting and lowering of a freely suspended load.

1.3 SUBMITTALS

A. Shop Drawings

1. Overhead Chain Operated Manual Traveling Crane.

2. Crane runway system.

3. Description of operation.

B. Product Data

1. Design Criteria (2,500 pound).

2. Load and Sizing Calculations.

3. Bumpers.

4. End Stops.

5. Spare Parts.

6. Framed Instructions.

7. Nameplates.

C. Test Reports

1. Hook Assembly including hook proof test and hook and nut non-destructive Test Report.

D. Certificates

1. Overload Test Certificate.

2. No Hazardous Material.

3. Crane Runway System including listed Standards.

4. Wire Ropes including manufacturer's certificate of breaking strength. Submit under provisions of Section 01300.

E. Operation and Maintenance Data and Manuals.

F. Manufacturer Qualification: Overhead Chain Operated Manual Traveling Crane shall be designed and manufactured by a company with a minimum of 10 years of specialized experience in designing and manufacturing the type of overhead crane required to meet requirements of the Contract Documents.

G. Pre-Delivery Inspections: Contractor is responsible for performance of quality control inspections, testing and documentation of steel castings, hook assembly as follows. Submit all crane test data recorded on appropriate test record forms suitable for retention for the life of the crane.

H. Certificates: Submit an Overload Test Certificate stating that the crane can be periodically load tested to 125 percent (plus 5 to minus 0) of rated load. Also submit the following certificates:

1. Stating that No Hazardous Material is contained within system or components.

2. Stating that the Crane Runway System conforms to the requirements as specified herein and as specified in Section 05 12 00 Structural Steel.

3. Certificate of Compliance with listed Standards

I. Overhead Crane

1. Submit shop drawings showing the general arrangement of all components in plan, elevation, and end views; hook approaches on all four sides, clearances and principal dimensions, assemblies of hoist, trolley and bridge drives.

2. Shop drawing quality shall be equivalent to the contract drawings.

3. Provide integral schedule of crane components on each drawing. Provide maximum wheel loads (without impact) and spacing imparted to the crane runway system track beams.

J. Welding Qualifications and Procedures: Perform welding in accordance with qualified procedures using AWS D14.1/D14.1M as modified. Written welding procedures shall specify the Contractor's standard dimensional tolerances for deviation from camber and sweep and not exceed those specified in AWS D14.1/D14.1M. Perform all welding indoors. Qualify welders and welding operators in accordance with AWS D1.1/D1.1M or AWS D14.1/D14.1M. Allowable stress values shall comply with CMAA 70.

K. Safety Requirements: Comply with the mandatory and advisory safety requirements of ASME B30.2 ASME B30.10, ASME B30.16, ASME HST-1,ASME HST-4, NFPA 70, 29 CFR 1910, 29 CFR 1910.179, and 29 CFR 1910.306.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect all delivered and stored equipment from the weather, humidity, temperature variations, dirt and dust and other contaminates.

1.5 EXTRA MATERIALS

A. Submit spare parts data for each different item of material and equipment specified and/or as recommended by the manufacturer, after approval of the detail drawings and not later than 1 month prior to the date of beneficial occupancy.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials and equipment which are standard products of manufacturers regularly engaged in the fabrication of complete and totally functional cranes.

B. Nameplates: Secure nameplates to each major component of equipment with the manufacturer's name, address, type or style, model or catalog number, and serial number. Provide two bridge identification plates, one for each side of bridge. Provide noncorrosive metal identification plates with letters which are easily read from the floor.

C. Prohibited Use of Asbestos Products: Provide materials and products, required for designing and manufacturing cranes, which do not contain asbestos.

D. Capacity Plates: Two capacity plates indicating the crane capacity in pounds are required, one secured to each side of bridge. Fabricate each capacity plate with a steel backing plate and exterior quality/fade-resistant stick-on labels with letters large enough to be easily read from the floor. Place capacity plates in a location visible to pendant operator's position after the crane has been installed.

E. Safety Warnings: Affix labels in a readable position to each lift block or control pendant in accordance with ASME B30.16, ASME B30.2 and ASME B30.17. Submit safety warnings, diagrams and other framed instructions suitably framed and protected for display as indicated by the Contracting Officer as follows:

1. Design and locate the word "WARNING" or other legend to bring the label to the attention of the operator. Provide durable type warning labels and display the following information concerning safe-operating procedures: Cautionary language against lifting more than the rated load; operating the hoist when the hook is not centered under the hoist; operating hoist with twisted, kinked or damaged rope; operating damaged or malfunctioning hoist; operating a rope hoist with a rope that is not properly seated in its hoist drum groove; lifting people; lifting loads over people; and removing or obscuring the warning label.

2.2 STRUCTURAL MATERIALS

A. Bolts, Nuts, and Washers: Bolts, nuts and washers shall conform to ASTM A 325 bolts or ASTM A 307. Galvanized bolts are not acceptable.

B. Bridge Girder or Girders: Provide wide flange beam, standard I-Beam, reinforced beam or section fabricated from rolled plates and shapes.

C. Bridge Rails or Bars: Trolley runway rails, crane girders and other sections shall be straight and true. Calculate the deflection with the worst case of two loaded bridge cranes located adjacent each other. Make all rail joints flush and true without misalignment of running tread and design to minimize vibration. The gap between adjacent rail ends and the vertical misalignment of running treads shall not exceed 0.0625 inch. Level the bridge rail to a plus-or-minus 1/8-inch at all rail support joints. Fasten bridge rail to wide flange complete with welded clips. Bolt bridge rail joints using standard joint bars. Stagger rail joints. Provide a positive stop at bridge rail ends to prevent creep.

D. End Ties and Bridge Girder End Connections: Use welded steel box sections for end ties. Provide full depth diaphragms at girder connections and jacking points. Provide horizontal gusset plates at the elevation of top and bottom end tie flanges for connection to girder ends. Make end connections with high-strength bolts. Use body-bound bolts fitted in drilled and reamed holes to maintain the crane square.

E. Bridge End Trucks: Provide axle type end trucks fabricated of structural tubes or from structural steel to provide a rigid box section structure.

F. Trolley Frame: Provide trolley frame consisting of two structural steel side frames or trucks welded together with one or more structural steel load girts to form a one-piece unit.

G. End Stops and Bumpers: Fit crane runways and bridge girders with structural steel end stops. Locate stops to permit maximum bridge and trolley travel.

H. Runway Rails: Provide runway rail size as specified in Drawings.

2.3 MECHANICAL EQUIPMENT

A. Wheels: Provide wheels manufactured of rolled or forged steel. Trolley and bridge wheels shall have straight treads. Equip wheels with self-aligning double-row spherical roller-bearings of capacity as recommended by bearing manufacturer for design load of trolley or bridge.

B. Bearings: All bearings, except those subject to a small rocker motion, shall be anti-friction type. Provide a means for lubrication for bearings not considered lifetime lubricated by the manufacturer. Equip equalizer sheaves with sintered oil-impregnated type bushings in accordance with ASTM B 438 or ASTM B 439.

C. Anti-Drip Provisions: Design cranes to preclude leakage of lubricants onto the lifted loads, floor, or external grounds. Fit all equipment and components which cannot be made leak-proof with suitable drip pans. Drip pans shall be manufactured of steel and designed to permit removal of collected lubricant.

D. Operational Provisions: Provide a chain operated lift and trolley capable of being operated through the limits of the rails and Bridge by one individual.

PART 3 - EXECUTION

3.1 EXAMINATION

A. After becoming familiar with all details of the work, and before performing any work, verify all dimensions in the field, and submit a letter describing the results of this verification, including discrepancies, to the Contracting Officer and crane manufacturer. The Contractor is responsible for the coordination and proper relation of the contracted work to the building structure and to the work of all trades. Verify all dimensions of the building that relate to fabrication of the crane and notify the Contracting Officer of any discrepancy before finalizing the crane order.

3.2 ERECTION

A. General: Perform the entire crane erection in accordance with manufacturer's instructions under the full-time supervision of the manufacturer's representative. Provide a written certificate from crane manufacturer indicating the crane is erected in accordance with manufacturer's recommendations before testing the completed installation.

B. Shop Assembly: Shop assemble major crane components as completely as possible. Match mark disassembled parts and tag electrical connections after complete no-load shop testing. Protect all parts and equipment at site from weather, damage, abuse and loss of identification. Erection. Procedures shall ensure that the crane is erected without initial stresses, forced or improvised fits, misalignments, nicks of high-strength structural steel components, stress-raising welds and rough burrs. Clean and repaint damaged surfaces after crane is erected. Provide all necessary grease and oil of approved quality and grade for the initial servicing and field test.

C. Welding: Welders, welding operations and welding procedures shall be qualified or pre-qualified in accordance with AWS D14.1 Perform welding indoors. Surface of parts to be welded shall be free from rust, scale, paint, grease or other foreign matter. Minimum preheat and interpass temperatures shall conform to the requirements of AWS D14.1. Perform welding in accordance with written procedures which specify the Contractor's standard dimensional tolerances for deviation from camber and sweep. Such tolerances shall not exceed those specified in accordance with AWS D14.1. Perform welding of girders and beams conforming to AWS D14.1.

D. Field Painting: Painting required for surfaces not otherwise specified, and finish painting of items only primed at the facility, shall conform to specified in Section 099000 - Painting and Protective Coatings. Paint bridge crane including bridge, trolley, hoist and all attached items in accordance with the manufacturer's standard practice. The complete crane shall be of one color. Paint bridge rail, supports and bracing in accordance with Section 099000 - Painting and Protective Coatings. Do not paint items such as surfaces in contact with the rail wheels, wheel tread, hooks, wire rope, and nameplates.

3.3 ACCEPTANCE TESTING

A. General: Provide all personnel necessary to conduct the required testing, including but not limited to, crane operators, riggers, rigging gear and test weights. Perform testing in the presence of Contracting Officer. Notify the Contracting Officer 10 days prior to testing operations. Operate all equipment and make all necessary corrections and adjustments prior to the testing operations witnessed by Contracting Officer. A representative of the Contractor responsible for procuring and installing hoist equipment shall be present to direct the field testing. Do not perform operational testing until after building interior has been painted. Furnish three copies of all test reports to Contracting Officer.

1. Test Sequence: Test crane in accordance with applicable paragraphs of this procedure in the sequence provided.

2. Monitor improper operation or poor condition of safety devices, mechanical equipment and structural assemblies during the load test. Report defects observed to be critical during the testing period immediately to the Contracting Officer and suspend the testing operations until the defects are corrected. During each load test and immediately following each load test, make the following inspections:

   a. Inspect for evidence of bending, warping, permanent deformation, cracking or malfunction of structural components.

   b. Inspect for evidence of slippage in wire rope sockets and fittings.

   c. Inspect gears for abnormal wear patterns, damage, or inadequate lubrication.

   d. Verify that locations of crane capacity plates are visible from pendant operator's position.

B. Trolley Travel: Operate trolley the full distance of bridge rails.

C. Bridge Travel: Operate bridge in each direction the full distance of runway.

D. Overload Test: After the operational tests, test bridge crane system and all functions of bridge crane at 125 percent of rated load.

E. Adjustment and Repairs: Perform adjustments and repairs under the direction of the Contracting Officer at no additional cost to the Government, until satisfactory conditions are maintained, and contract compliance is affected. After adjustments are made to assure correct functioning of the components, repeat pertinent testing.

3.4 SCHEMATIC DIAGRAMS

A. Store Schematic diagrams for equipment where indicated on drawings.

3.5 MANUFACTURER'S FIELD SERVICE REPRESENTATIVE

A. Furnish a qualified experienced manufacturer's field service representative to supervise the crane installation, assist in the performance of the on-site testing, and instruct personnel in the operational and maintenance features of the equipment.

3.6 OPERATION AND MAINTENANCE MANUALS

A. Provide three copies of operation and three copies of maintenance manuals for the equipment furnished and one electronic copy. One complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for system operation. Include the manufacturer's name, model number, parts list, and brief description of all equipment and basic operating features.

3.7 FINAL ACCEPTANCE

A. Final acceptance of crane system will not be given until Contractor has successfully completed all testing operations, corrected all material and equipment defects, made all proper operation adjustments, and removed paint or overspray on equipment.

END OF SECTION 14 47 00

DIVISION 22

PLUMBING

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 22 05 23 — VALVES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all valves, actuators, check valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls indicated in other Sections of the Specifications.

C. A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the Manufacturer of the valve.

D. Where two or more valves of the same type or size are required, the valves shall be furnished by the same Manufacturer.

1.2 CONTRACTOR SUBMITTALS

A. Submittals shall be furnished in accordance with Division 1 – SUBMITTAL PROCEDURES.

B. Shop drawings shall contain the following information:

1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.
2. Complete information on valve actuator, including size, Manufacturer, model number, limit switches, and mounting.
3. Cavitation limits for all control valves.
4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.
5. Complete wiring diagrams and control system schematics.
6. Valve Labeling: A schedule of valves to be labeled, indicating in each case the valve location and the proposed wording for the label.

C. The Owner's Manual shall contain the required information for each valve.

D. A Spare Parts List shall contain the required information for each valve assembly, where indicated.

E. Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials shall be suitable for the intended application. Materials not specified shall be high-grade standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise specified, valve bodies shall conform to the following requirements:

1. Cast iron valve bodies shall be of close-grained gray cast iron, conforming to ASTM A 48 - Specification for Gray Iron Castings, Class 30, or to ASTM A 126 - Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. Ductile iron valve bodies shall conform to ASTM A 536 - Specification for Ductile Iron Castings, or to ASTM A 395 - Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
3. Steel valve bodies shall conform to ASTM A 216 - Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service, or to ASTM A 515 - Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.
4. Bronze valve bodies shall conform to ASTM B 62 - Specification for Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Specification for Copper Alloy Sand Castings for General Applications.
5. Stainless steel valve bodies and trim shall conform to ASTM A 351 - Specification for Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.

2.2 VALVE CONSTRUCTION

A. Valve bodies shall be cast, forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. All welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected.

B. Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.

C. Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Where subject to dezincification, bronze valve stems shall

conform to ASTM B 62, containing not more than 5 percent of zinc or more than 2 percent of aluminum, with a minimum tensile strength of 60,000 psi, a minimum yield strength of 40,000 psi, and an elongation of at least 10 percent in 2 inches. Where dezincification is not a problem, bronze conforming to ASTM B 584 may be used.

D. Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.

2.3 VALVE ACCESSORIES

A. All valves shall be furnished complete with the accessories required to provide a functional system.

2.4 SPARE PARTS

A. Where indicated, the CONTRACTOR shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. All spare parts are intended for use by the OWNER, only, after expiration of the guarantee period.

2.5 MANUFACTURERS

A. All valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the valves indicated.

2.6 VALVES

A. All valves and gates shall be new and of current manufacture. All shut-off valves 6-inches and larger shall have actuators with position indicators. Gate type shut-off valves shall be either rising stem or OS&Y type. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.

B. The exterior surfaces of all valves and the wet interior surfaces of all ferrous valves of sizes 4 inches and larger shall be coated in accordance with Section 09 92 00 – PIPE PAINTING. The valve Manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications. Flange faces of valves shall not be epoxy coated.

C. Except when such requirement is waived by the ENGINEER in writing, a label shall be provided on all shut-off valves and control valves except for hose bibbs and chlorine cylinder valves. The label shall be of 1/16-inch plastic or stainless steel, minimum 2 inches by 4 inches in size, as indicated in Section 15005 - Piping Identification Systems, and shall by permanently attached to the valve or on the wall adjacent to the valve as directed by the ENGINEER.

D. As a minimum, unless otherwise indicated, each valve body 4 inches and larger shall be tested hydrostatically to 1.5 times its rated 100 degrees F design water-working pressure, for a period of 5 minutes, without showing any leaks or loss of pressure. In addition, each valve 4 inches and larger shall undergo a functional test to demonstrate satisfactory operation throughout its operating cycle, and a closure test at rated 100 degrees F water-working pressure for a period of 5 minutes to demonstrate tight shut-off. Stem seal leakage shall not be a cause for rejection. All valves 3 inches and smaller shall undergo the Manufacturer's standard test.

E. Prior to shipment, the CONTRACTOR shall submit for all valves over 12 inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, and ASTM.

F. All valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.7 BALL VALVES

A. Up to 2 inches: Bronze or stainless steel one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle, solder or threaded ends.

B. Over 2 inches: Cast steel flanged body, chrome plated steel ball, Teflon seat and stuffing box seals and lever handle.

2.8 CHECK VALVES

A. Swing check valves for water, sewage, sludge, and general service shall be of the outside lever and spring or weight type, in accordance with ANSI/AWWA C 508 - Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS, unless otherwise indicated, with full-opening passages, designed for a water-working pressure of 150 psi. They shall have a flanged cover piece to provide access to the disc.

B. The valve body and cover shall be of cast iron conforming to ASTM A 126 - Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with flanged ends conforming to ANSI/ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or mechanical joint ends, as indicated.

C. The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B 62 - Specification for Composition Bronze or Ounce Metal Castings.

D. The valve seat and rings shall be of bronze to conforming ASTM B 62 or B 148 - Specification for Aluminum-Bronze Castings, or of Buna-N.

E. The hinge pin shall be of bronze or stainless steel.

F. Manufacturers, or Equal:

1. American Flow Control (Darling)
2. APCO (Valve and Primer Corp.)
3. Kennedy Valve

4. Mueller Company (Grinnell Corporation)
5. Stockham Valves and Fittings

2.9 BALANCING VALVES

A. Manually operated: Y pattern globe style design with soldered or threaded ends. Nonferrous, brass body, EPDM o-ring seals.

2.10 PRESSURE RELIEF VALVES

A. Pressure Reducing Valves shall be hydraulically operated, diaphragm actuated, pilot controlled globe valves, with cast iron, ductile iron, or steel body, ANSI B16.1 flanged ends, rated 175 psi, Bronze or stainless steel trim, stainless steel stem. Pilot system shall include externally mounted strainers with cocks. Valves shall be capable of relieving excess upstream. Provide off-seat limit switch.

B. Manufacturers, or Equal:
   1. Cla-Val Company
   2. Bermad
   3. Golden-Anderson

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. All valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the Manufacturer's written instructions and as indicated. All gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. All valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.

C. Where combinations of valves, sensors, switches, and controls are indicated, the CONTRACTOR shall properly assemble and install such items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

END OF SECTION 22 05 23

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 22 05 29 - PIPING SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this Section:
   1. American Society for Testing and Materials (ASTM):
      a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
   2. Building Officials and Code Administrators (BOCA): Basic Building Code.
   3. International Conference of Building Officials (ICBO): Uniform Building Code.
   4. Manufacturers' Standardization Society (MSS):
      a. SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture.
      b. SP 69, Pipe Hangers and Supports - Selection and Application.
      c. SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.

1.2 DEFINITIONS

A. Wetted or Submerged: Submerged, less than 1 foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Drawings of piping support system, locating each support, brace, hanger, guide, component, and anchor. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
   2. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.

B. Information Submittals: Maintenance information on piping support system.

1.4 QUALIFICATIONS

A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Registered Professional Engineer in the State of Alaska.

1.5 DESIGN REQUIREMENTS

A. General:
   1. Seismic Load: Seismic performance category forces with seismic loads in accordance with local codes.
   2. Design, size, and locate piping support systems throughout facility, whether shown or not.

3. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
4. Piping 30 Inches and Larger: Support systems have been designed for piping shown.
5. Meet requirements of MSS SP 58, MSS SP 69, and MSS SP 89, or as modified by this section.

B. Pipe Support Systems:
1. Support Load: Dead loads imposed by weight of pipes filled with water, except air and gas pipes, plus insulation.
2. Maximum Support Spacing and Minimum Rod Size:
a. Mild Steel or Ductile Iron Piping (Note that this spacing may require the use of higher load pipe clamps and more than a single point anchor in concrete):

Pipe Size	Maximum Support/ Hanger Spacing	Minimum Rod Size Single Rod Hangers
1" & smaller	6 feet	1/4"
1-1/2" through 2-1/2"	8 feet	1/4"
3" & 4"	10 feet	3/8"
6"	12 feet	3/8"
8"	12 feet	1/2"
10" & 12"	14 feet	5/8"
14"	16 feet	3/4"
16" & 18"	16 feet	7/8"

b. Copper Piping:
1) Maximum Support Spacing: 2 feet less per size than listed for steel pipe, with 1-inch and smaller pipe supported every 5 feet.
2) Minimum Hanger Rod Sizing: Same as listed for steel pipe.

C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

D. Vertical Sway Bracing: 10-foot maximum centers, or as shown.

E. Existing Support Systems: Use existing supports systems to support new piping only if CONTRACTOR can show that they are adequate for additional load, or if they are strengthened to support additional load.

PART 2 - PRODUCTS

2.1 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated by catalogs.

B. Special support and hanger details are shown for cases where standard catalog supports are inapplicable.

C. Materials: Hot-dipped galvanized after fabrication, conforming to ASTM A123 or coated system No. 5 as specified in Section 09 92 00, PIPE PAINTING.

2.2 HANGERS

A. Clevis Type: MSS SP 58 and SP 69, Type 1 or 6.
   1. Anvil; Figure 104 or 260.
   2. B-Line; Figure B3198 or B3100.

B. Hinged Split-Ring Pipe Clamp: MSS SP 58 and SP 69, Type 6 or 12.
   1. Anvil; Figure 104.
   2. B-Line; Figure B3198H.

C. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

D. Attachments:
   1. I-Beam Clamp: Concentric loading type, MSS SP 58 and SP 69, Type 21, 28, 29, or 30, which engage both sides of flange.
   2. Concrete Insert: MSS SP 58 and SP 69, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.

2.3 SADDLE SUPPORTS

A. Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
   1. Nonadjustable Saddle: MSS SP 58 and SP 69, Type 37 with U-bolt.
      a. Anvil; Figure 259.
      b. B-Line; Figure B3090.
   2. Adjustable Saddle: MSS SP 58 and SP 69, Type 38 without clamp.
      a. Anvil; Figure 264.
      b. B-Line; Figure B3093.

2.4 WALL BRACKETS

A. Welded Steel Bracket: MSS SP 58 and SP 69, Type 33 (heavy-duty).
   1. Anvil; Figure 199.
   2. B-Line; Figure B3067.

B. One-Hole Clamp: Grinnell; Figure 126.

C. Channel Type:
   1. Unistrut.
   2. Anvil; Anvil-Strut.
   3. B-Line; Strut System.
   4. Aickinstrut (FRP).

2.5 PIPE CLAMPS

A. Riser Clamp: MSS SP 58 and SP 69, Type 8.
   1. Anvil; Figure 261.
   2. B-Line; Figure B3373.

2.6 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, 1-1/2-inch wide, minimum FRP.

B. Members and Connections: Design for all loads with safety factor of 5.

C. Manufacturers:
   1. B-Line; Strut System.
   2. Unistrut.
   3. Anvil; Anvil-Strut.
   4. Aickinstrut (FRP System).

2.7 ACCESSORIES

A. Insulation Shields:
   1. Type: Galvanized steel or stainless steel, MSS SP 58 and SP 69, Type 40.
   2. Manufacturers and Products:
      a. Anvil; Figure 167.
      b. B-Line; Figure B3151.

B. Welding Insulation Saddles:
   1. Type: MSS SP 58 and SP 69, Type 39.
   2. Manufacturers and Products:
      a. Anvil; Figure Series 160.
      b. B-Line; Figure Series B3160.

C. Vibration Isolation Pads:
   1. Type: Neoprene Waffle.
   2. Manufacturers and Products:
      a. Mason Industries; Type W.
      b. Korfund; Korpad 40.

2.8 PIPE ANCHORS

A. Type: Anchor chair with U-bolt strap.

B. Manufacturers and Products:
   1. Anvil; Figure 198.
   2. B-Line; Figure B3147A or B3147B.

2.9 ANCHORING SYSTEMS

A. Size: Sized by component manufacturer, 1/2-inch minimum diameter, and as shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install support systems in accordance with MSS SP 69 and MSS SP 89, unless shown otherwise.
2. Support piping connections to equipment by pipe support and not by equipment.
3. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
4. Support no pipe from pipe above it.
5. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
6. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
7. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
8. Install lateral supports for seismic loads at all changes in direction.
9. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
10. Repair mounting surfaces to original condition after attachments are made.

B. Standard Pipe Supports:
1. Horizontal Suspended Piping:
   a. Single Pipes: Adjustable swivel-ring, split-ring, or clevis hangers.
   b. Grouped Pipes: Trapeze hanger systems.
   c. Furnish galvanized steel protection shield and oversized hangers for insulated pipe.
   d. Furnish precut sections of rigid insulation with vapor barrier at hangers for insulated pipe.
2. Horizontal Piping Supported From Walls:
   a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
   b. Stacked Piping:
      1) Wall mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.
      2) Piping clamps that resist axial movement of pipe through support not acceptable.
   c. Wall mounted piping clips not acceptable for insulated piping.
3. Horizontal Piping Supported From Floors:
   a. a. Stanchion Type:
      1) Pedestal type; adjustable with stanchion, saddle, and anchoring flange.
      2) Use yoked saddles for piping whose centerline elevation is 18 inches or greater above floor and for exterior installations.
      3) Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.
   b. b. Floor Mounted Channel Supports:
      1) Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
      2) Attach channel framing to floors with anchor bolts. 3) Attach pipe to channel with clips or pipe clamps.
   c. Concrete Cradles: Use for piping larger than 3 inch along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.

4. Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.
5. Standard Attachments:
   a. To Concrete Ceilings: Concrete inserts.
   b. To Steel Beams: I-beam clamp or welded attachments.
   c. To Wooden Beams: Lag screws and angle clips to members not less than 2-1/2 inches thick.
   d. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.
6. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.

C. Accessories:
1. Insulation Shield: Install on insulated nonsteel piping. Oversize rollers and supports.
2. Welding Insulation Saddle: Install on insulated steel pipe. Oversize rollers and supports.
3. Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.
4. Dielectric Barrier:
   a. Install between carbon steel members and copper or stainless steel pipe.
   b. Install between stainless steel supports and nonstainless steel ferrous metal piping.
5. Electrical Isolation: Install 1/4-inch by 3-inch neoprene rubber wrap between submerged metal pipe and oversized clamps.

3.2 FIELD FINISHING

A. Paint atmospheric exposed surfaces and hot-dip galvanized steel components as specified in Section 09 92 00, PIPE PAINTING.

END OF SECTION 22 05 29

SECTION 22 10 00 - PROCESS PIPING - GENERAL

PART 1 - GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American National Standards Institute (ANSI):
      a. B1.20.1, Pipe Threads, General Purpose (Inch).
      b. B16.1, Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
      c. B16.3, Malleable Iron Threaded Fittings.
      d. B16.5, Pipe Flanges and Flanged Fittings.
      e. B16.9, Factory-Made Wrought Steel Buttwelding Fittings.
      f. B16.11, Forged Fittings, Socket-Welding and Threaded.
      g. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
      h. B16.25, Butt Welding Ends.
   2. American Society of Mechanical Engineers (ASME):
      a. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
      b. B31.3, Process Piping.
      c. B31.9, Building Services Piping.

   B36.10M, Welded and Seamless Wrought Steel Pipe.
   3. American Society for Testing and Materials (ASTM):
      a. A47, Standard Specification for Ferritic Malleable Iron Castings.
      b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
      d. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
      e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      f. A135, Standard Specification for Electric-Resistance-Welded Steel Pipe.
      g. A139, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).
      h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      i. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
      j. A182/A182M, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
      k. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.
      l. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
      m. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service or Both.
      n. A197/A197M, Standard Specification for Cupola Malleable Iron.

o. A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
p. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
q. A240/A240M, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
r. A276, Standard Specification for Stainless Steel Bars and Shapes.
s. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
t. A285/A285M, Standard Specification for Pressure Vessel Plates, Carbon Steel, Low and Intermediate Tensile Strength.
u. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
v. A312/A312M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
w. A320/A320M, Standard Specification for Alloy/Steel Bolting Materials for Low-Temperature Service.
x. A536, Standard Specification for Ductile Iron Castings.
y. A563, Standard Specification for Carbon and Alloy Steel Nuts.
z. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
aa. B32, Standard Specification for Solder Metal.
bb. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
cc. D1330, Standard Specification for Rubber Sheet Gaskets.
dd. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
ee. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
ff. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
gg. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
hh. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
ii. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
jj. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
kk. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
ll. F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

4. American Water Works Association (AWWA):
   a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
   b. C110/A21.10, Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water and Other Liquids.
   c. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   d. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   e. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.

f. C153/A21.53, Ductile-Iron Compact Fittings 3 Inches Through 24 Inches and 54 Inches Through 64 Inches, for Water Service.
g. C200, Steel Water Pipe - 6 Inches and Larger.
h. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inches and Larger - Shop Applied.
i. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 Inches Through 144 Inches.
j. C208, Dimensions for Fabricated Steel Water Pipe Fittings.
k. C213, Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
l. M11, Steel Pipe - A Guide for Design and Installation.
m. American Welding Society (AWS):
n. A5.8, Specification for Filler Metals for Brazing and Braze Welding.
o. QC 1, Standard for AWS Certification of Welding Inspectors.

5. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
   a. SP43, Wrought Stainless Steel Butt-Welding Fittings Including Reference to Other Corrosion Resistant Materials.
6. NSF International
   a. NSF: 61 Drinking Water System Components - Health Effects.
7. National Electrical Manufacturers Association (NEMA)

LI 1, Industrial Laminated Thermosetting Products.
   a. National Fire Protection Association
   b. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances

1.2 DEFINITIONS

A. Submerged or Wetted:
   1. Zone below elevation of:
      a. Top face of channel walls and cover slabs.
      b. Liquid surface or within 3 feet above top of liquid surface.

1.3 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
   1. Process Piping: ASME B31.3.
   2. All piping and wetted components of potable water systems shall conform to ANSI/NSF standard 61.
   3. Building Service Piping: ASME B31.3, as applicable.
   4. Sanitary Building Drainage and Vent Systems: Local plumbing code.
   5. Thrust Restraints:
      a. Design for test pressure shown in Piping Schedule.
      b. Allowable Soil Pressure: 1,000 pounds per square foot.
      c. Low Pressure Pipelines:
         1) When bearing surface of the fitting against soil provides an area equal to or greater than area required for thrust restraint, concrete thrust blocks will not be required.

2) Determine bearing area for fittings without thrust blocks by projected area of 70 percent of internal diameter multiplied by chord length for fitting centerline curve.

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

B. Shop Drawings:
1. Shop Fabricated Piping:
   a. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
2. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
3. Pipe Corrosion Protection: Product data.

C. Information Submittals:
1. Laboratory Testing Equipment: Certified calibrations, manufacturer's product data, and test procedures.
2. Certified welding inspection and test results.
3. Qualifications:
   a. Weld Inspection and Testing Agency: Certification and qualifications.
   b. Welding Inspector: Certification and qualifications.
   c. Welders:
      1) List of qualified welders and welding operators.
      2) Current test records for qualified welder(s) and weld type(s) for factory and field welding.
4. Weld Procedures: Records in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
5. Nondestructive inspection and testing procedures.
6. Manufacturer's Certification of Compliance:
   a. Pipe and fittings.
   b. Welding electrodes and filler materials.
7. Test logs.

1.5 QUALIFICATIONS

A. Independent Inspection and Testing Agency:
1. Ten years' experience in field of welding and welded pipe and fittings' testing required for this Project.
2. Calibrated instruments and equipment, and documented standard procedures for performing specified testing.
3. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.
4. Testing Personnel: Qualified for nondestructive test methods to be performed.
5. Inspection Services: Qualified welding inspector.

B. Welding Inspector: AWS certified, AWS QC 1 qualified, with prior inspection experience of welds specified.

C. Welder and Welding Operator Qualifications:
   1. Qualified by accepted inspection and testing agency before starting Work in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.
   2. Qualified to perform groove welds in Positions 2G and 5G for each welding process and pipe material specified.
   3. Qualification tests may be waived by ENGINEER based on evidence of prior qualification.
   4. Retesting: Upon ENGINEER's written request, retest qualified welder(s).

1.6 QUALITY CONTROL

A. Provide services of independent inspection and testing agency for welding operations.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.

B. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.

C. Linings and Coatings: Prevent excessive drying.

D. Cold Weather Storage: Locate products to prevent coating from freezing to ground.

E. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 - PRODUCTS

2.1 PIPING

A. Steel piping shall be as specified in Section 22 11 00 STEEL PIPE.

B. Copper piping shall be ASTM B88, Type L, hard drawn.

C. Drain and Vent Piping:
   1. ABS Piping
      a. Piping: ASTM D 2661, Schedule 40 Solid Wall
      b. ABS Socket Fittings: ASTM D 2661 made to ASTM D 3311
      c. Solvent: ASTM D 2235
   2. PVC Piping
      a. Piping: ASTM D 2665, Schedule 40 Solid Wall
      b. PVC Socket Fittings: ASTM D 2665 made to ASTM D 3311
      c. Primer: ASTM F 656
      d. Solvent: ASTM D 2564

2.2 JOINTS

A. Flanged Joints:

1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

B. Threaded Joints: NPT taper pipe threads in accordance with ANSI B1.20.1.

C. Thrust Tie-Rod Assemblies: NFPA 24; tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.

D. Flexible Mechanical Compression Joint Coupling:
1. Stainless steel, ASTM A276, Type 305 bands.
2. Manufacturers:
   a. Pipeline Products Corp.
   b. Fernco Joint Sealer Co.

2.3 GASKET LUBRICANT

A. Lubricant shall be supplied by pipe manufacturer and no substitute or “or-equal” will be allowed.

2.4 PIPE CORROSION PROTECTION

A. Coatings: See Section 09 92 00, PIPE PAINTING for details of coating requirements.

2.5 VENT AND DRAIN VALVES

A. 2-Inch Diameter and Smaller: 1/2-inch vent, 1-inch drain, unless shown otherwise.

B. 2-1/2-Inch Diameter and Larger: 3/4-inch vent, 1-inch drain, unless shown otherwise.

2.6 FABRICATION

A. Mark each pipe length on outside:
1. Size or diameter and class.
2. Manufacturer’s identification and pipe serial number.
3. Location number on laying drawing.
4. Date of manufacture.

B. Code markings according to approved Shop Drawings.

C. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Welding Electrodes: Verify proper grade and type, free of moisture and dampness, and coating is undamaged.

3.2 PREPARATION

A. See Section 09 92 00, PIPE PAINTING for additional requirements.

B. Notify ENGINEER at least 2 weeks prior to field fabrication of pipe or fittings.

C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

D. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

3.3 WELDING

A. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.3 for Pressure Piping.

B. Weld Identification: Mark each weld with symbol identifying welder.

C. Pipe End Preparation:
1. Machine Shaping: Preferred.
2. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
3. Beveled Ends for Butt Welding: ANSI B16.25.

D. Surfaces:
1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
2. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

E. Alignment and Spacing:
1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
2. Root Opening of Joint: As stated in qualified welding procedure.
3. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 1-inch, whichever is greater.

F. Climatic Conditions:
   1. Do not perform welding if there is impingement of any rain, snow, sleet, or high wind on the weld area, or if the ambient temperature is below 32 degrees F.

G. Tack Welds: Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

H. Surface Defects: Chip or grind out those affecting soundness of weld.

I. Weld Passes: As required in welding procedure.

J. Weld Quality: Free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity slag inclusions, and other defects in excess of limits shown in applicable piping code.

3.4 INSTALLATION-GENERAL

A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

C. Flanged Joints:
   1. Install perpendicular to pipe centerline.
   2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
   3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
   4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
   5. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
   6. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
   7. Threaded flanged joints must be shop fabricated and delivered to jobsite with flanges in-place and properly faced.
   8. Manufacturer: Same as pipe manufacturer.

D. Threaded and Coupled Joints:
   1. Conform to ANSI B1.20.1.
   2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
   3. Countersink pipe ends, ream and clean chips and burrs after threading.
   4. Make connections with not more than three threads exposed.
   5. Lubricate male threads only with thread lubricant or Teflon tape.

E. Soldered Joints:
   1. Use only lead-free solder.
   2. Cut pipe ends square and remove fins and burrs.
   3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.

4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

3.5 INSTALLATION-EXPOSED PIPING

A. Piping Runs:
1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified in Section 22 05 29, PIPING SUPPORT SYSTEMS.

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

F. Piping clearance, unless otherwise shown:
1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet 0 inch, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
3. From Adjacent Work: Minimum 1-inch from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.6 PIPE CORROSION PROTECTION

A. Carbon Steel Pipe:
1. Exposed: As specified in Section 09 92 00, PIPE PAINTING.
2. Submerged or Embedded: Shop coat with coal-tar epoxy as specified in Section 09 92 00, PIPE PAINTING.

B. Copper Pipe: Exposed: As specified in Section 09 92 00, PIPE PAINTING.

C. Piping Accessories:
   1. Exposed:
      a. Field paint black and galvanized steel, brass, copper, and bronze piping components as specified in Section 09 92 00, PIPE PAINTING as applicable to base metal material.
      b. Accessories include, but are not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners.
      c. Cement-Coated Pipelines: Cement coat appurtenances same as pipe.

D. Insulating Flanges, Couplings, and Unions:
   1. Applications:
      a. Dissimilar metal piping connections.
      b. Cathodically protected piping penetration to buildings and watertight structures.
      c. Submerged to unsubmerged metallic piping connections.
      d. Where required for electrically insulated connection.
   2. Pipe Installation:
      a. Insulating joints connecting immersed piping to nonimmersed piping shall be installed above maximum water surface elevation.
      b. Submerged carbon steel, ductile iron, or galvanized piping in reinforced concrete shall be isolated from the concrete reinforcement steel.
      c. Align and install insulating joints according to manufacturer's recommendations to avoid damaging insulating materials.

3.7 THRUST RESTRAINT

A. Location: Exposed Piping: At all joints in piping.

B. Thrust Ties:
   1. Steel Pipe: Attach with fabricated lugs.
   2. Flanged Coupling Adapters: For exposed installations, install manufacturer’s anchor studs through the coupling sleeve.

3.8 BRANCH CONNECTIONS

A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including the first block valve in the line carrying the lower pressure, unless otherwise shown.

C. Threaded Pipe Tap Connections:
   1. Welded Steel Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.
   2. Limitations: Threaded taps in pipe barrel are unacceptable.

3.9 VENTS AND DRAINS

A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines as shown.

3.10 CLEANING

A. Following assembly and testing, and prior to final acceptance, flush pipelines (except as stated below) with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

B. If impractical to flush large diameter pipe at 2.5 fps or blow at 4,000 fpm velocity, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

C. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.

D. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

3.11 FIELD FINISHING

A. Notify ENGINEER at least 3 days prior to start of any surface preparation or coating application work.

B. As specified in Section 09 92 00, PIPE PAINTING.

3.12 PIPE IDENTIFICATION

A. As specified in Section 09 92 00, PIPE PAINTING.

3.13 FIELD QUALITY CONTROL

A. Pressure Leakage Testing:
   1. Perform hydrostatic testing at the lesser of 150% of the working pressure or 150 psi.
   2. Perform testing on DWV piping per UPC.

B. Minimum Duties of Welding Inspector:
   1. Job material verification and storage.
   2. Qualification of welders.
   3. Certify conformance with approved welding procedures.
   4. Maintenance of records and preparation of reports in a timely manner.
   5. Notification to ENGINEER of unsatisfactory weld performance within 24 hours of weld test failure.

C. Required Weld Examinations:
   1. Perform examinations in accordance with Piping Code, ASME B31.3, except that 5 percent of the circumferential butt welds shall be random radiographed.

2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for all piping covered by this section.
3. Examine at least one of each type and position of weld made by each welder or welding operator.
4. For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two additional welds for each tracer examination found to be unsatisfactory.

END OF SECTION 22 10 00

SECTION 22 11 00 - STEEL PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies steel pipe and fittings.

1.2 RELATED SECTIONS

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 the proper performance of this work. It is the Contractor's responsibility to perform all the work required by the Contract Documents.

1. Section 22 10 00: PROCESS PIPING - GENERAL

1.3 QUALITY ASSURANCE

A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.

Reference	Title
ANSI B16.3	Malleable Iron Threaded Fittings, Class 150 and 300
ANSI B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ANSI B16.11	Forged Steel Fittings, Socket-Welding and Threaded
ASTM A36/A36M	Structural Steel
ASTMA47	Ferritic Malleable Iron Castings
ASTMA53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A105/A105M	Forgings, Carbon Steel, for Piping Components
ASTM A106 REV A	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A197	Cupola Malleable Iron
ASTM A234/A234M	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A283/A283M REV A	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTMA536	Ductile Iron Castings
ASTM A570/A570M	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
ASTM A572/A572M REV B	High Strength Low Alloy Columbium-Vanadium Steels of Structural Quality
AWWAC200	Steel Water Pipe 6 Inches and Larger

AWWAC205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe -4 In. and Larger -Shop Applied
AWWAC206	Field Welding of Steel Water Pipe
AWWAC207	Steel Pipe Flanges for Waterworks Services -Sizes 4 In. Through 144 In.
AWWAC208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWAC209	Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWAC210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe
AWWAC214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWAC600	Installation of Ductile-Iron Water Mains and Their Appurtenances AWWAM11 Steel Pipe -A Guide for Design and Installation
SSPC-SP10	Near-White Blast Cleaning

1.4 SUBMITTALS

A. Prior to delivering the product to the job site, provide the following submittals:

1. Manufacturer's product data, catalog cuts, or shop drawings describing construction, dimensions, and materials. Indicate on the submittal each Piping System where the product will be used.
2. Affidavits of Compliance with AWWA C200, ASTM A53, or ASTM A106 as applicable.
3. Drawings showing cross-section of the pipe wall and joints for each size, pressure rating, and loading and drawings showing details, dimensions, and piece numbers of all fabricated fittings.
4. Calculations for fabricated fittings that indicate the adequacy of any required reinforcement. Calculations shall be in accordance with the procedures presented in AWWA M11.
5. Submit calculations and drawings for proposed alternative thrust restraint or pipe anchorage. Calculations and drawings shall be stamped by a Washington State Professional Engineer.

1.5 TESTING

A. Factory testing shall conform to the requirements of ASTM A53, ASTM A106, or AWWAC200 as applicable.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Provide steel pipe and fittings in accordance with ASTM A53, ASTM A106, or AWWA C200.

B. Steel for pipe fabrication to meet requirements of AWWA C200 shall conform to the requirements of ASTM A36, ASTM A572, Grade 42, ASTM A570, Grades 33 and 36, or ASTM A283, Grade D. Steel for ASTM A53 and ASTM A 106 pipe shall be Grade B.

2.2 PIPE FABRICATION

A. ASTM A53 Pipe.: Unless otherwise indicated:

1. Type E, electric resistance welded or Type S, seamless.
2. Minimum wall thickness for ASTM A53 or ASTM A106: Schedule 40 for pipe 10-inch diameter and less and 3/8 inch for pipe 12-inch through 24-inch diameter.·
3. Increased shell thickness shall be provided where specified.
4. Pipes for potable water service 2” and smaller shall be schedule 40 galvanized steel.
5. Pipes for natural gas service shall be schedule 40 threaded black steel.

B. AWWA C200 Pipe:

1. 1: Straight or spiral seam.
2. Minimum Wall Thickness:
   a. 16-lnch and Smaller: 1/4 inch.
   b. 18-lnch and Larger: 3/8 inch.

C. Increased shell thickness shall be provided where specified.

2.3 FITTINGS AND APPURTENANCES

A. Malleable Iron Threaded Fittings and Appurtenances: In conformance with the requirements of ASTM A47 or ASTM A197, ANSI B16.3.

B. Steel Fittings and Appurtenances:

1. Unless otherwise indicated, in conformance with the requirements of ASTM A234, ASTM A105, or ANSI B16.11.
2. Fabricated Steel Fittings and Appurtenances: In conformance with AWWA C208.

C. Fittings for Grooved-End Piping Systems:

1. Full flow cast fittings, steel fittings, or segmentally welded fittings with grooves or shoulders designed to accept grooved end couplings.
2. Cast Fittings: Cast of ductile iron conforming to ASTM A536 or malleable iron conforming to ASTMA47.
3. Standard Steel Fittings, Including Large Size Elbows: Forged steel conforming to ASTM A106.
4. Standard Segmentally Welded Fittings: Fabricated of Schedule 40 carbon steel pipe.

D. Unless otherwise indicated, all fittings shall be rated for pressure and loadings equal to the pipe.

2.4 FLANGES

A. Provide flanges in accordance with AWWA C207, Table 2 Class D

2.5 PIPE LINING

A. Pipe and fittings for potable water service 3" and larger shall be lined with a liquid epoxy as specified in AWWA C210 and section 09 92 00 PIPE PAINTING.

2.6 PIPE COATING

A. Pipe and fittings shall be coated with a liquid epoxy as specified in AWWA C210 and section 09 92 00 PIPE PAINTING.

B. Polyethylene Tape:

1. Where specified, pipe and fittings shall be. coated and wrapped with prefabricated multilayer cold applied polyethylene tape coating in accordance with AWWA C214.
2. The coating application shall be a continuous step operation in conformance with AWWA C214, Section 3. The total coating thickness shall be not less than 50 mils for pipe 24 inches and smaller and not less than 80 mils for pipe 26 inches and larger.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install pipe in accordance with AWWA M11, Chapter 16. Weld joints in accordance with AWWA C206.
2. Provide sleeve-type mechanical pipe couplings in accordance with AWWA M11.
3. Apply pipe lining and coatings at field joints.
4. Anchorage:
   a. All couplings and fittings shall be restrained joint for thrust restraint.
   b. Provide concrete thrust blocks only where specified on the drawings.

3.2 TESTING

A. Hydrostatic testing shall be in accordance with Section 4 of AWWA C600.

END OF SECTION 22 11 00

SECTION 22 11 23 — DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all pumps complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to pumps except where otherwise indicated, and may require a combination of sensors, and controls indicated in other Sections of the Specifications.

C. A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each pump; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each pump. Unless indicated otherwise, the responsible manufacturer shall be the Manufacturer of the pump.

D. Where two or more pumps of the same type or size are required, the pumps shall be furnished by the same Manufacturer.

1.2 CONTRACTOR SUBMITTALS

A. Submittals shall be furnished in accordance with Division 1 – SUBMITTAL PROCEDURES.

B. Provide manufacturer's literature for all products specified in this section, which will be installed under this project.

C. Provide performance curves for all pumps. Plot the specified operating point for each pump on its respective curve.

D. Provide complete literature for all components of packaged systems. These include pump performance, data for all accessories and compete wiring diagrams specific to the exact unit to be supplied. The wiring diagram shall indicated all required fields and factory wiring.

E. A Spare Parts List shall contain the required information for each pump assembly, where indicated.

F. Where indicated, signed, dated, and certified factory test data for each pump requiring certification shall be submitted before shipment of the pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All pump manufacturers shall have a successful record of not less than 5 years in the manufacture of the pumps indicated.

2.2 PUMPS

A. Vertical Close Coupled Pump

1. The pumps shall be single stage end suction rear pull out design. The seal shall be serviceable without disturbing the piping connections. The capacities and characteristics shall be as called for in the plans/schedules.
2. Pump casing shall be constructed of ASTM A48 class 30 cast iron. The pump casing/volute shall be rated for 250 psi working pressure for all jobs. The pump flanges shall be matched to suit the working pressure of the piping components on the job, with either ANSI Class 125 flanges or ANSI class 250 flanges. The pump casing shall be drilled and tapped for gauge ports on both the suction and discharge connections and for a drain port at the bottom of the casing. The casing shall have an additional tapping on the discharge connection to allow for the installation of a seal flush line. The pump cover shall be drilled and tapped to accommodate a seal flush line which can be connected to the corresponding tapping on the discharge connection, or to an external source to facilitate cooling and flushing of the seal faces.
3. All casings shall be flanged.
4. The pump shall have a factory installed vent/flush line to insure removal of trapped air from the casing and mechanical seal cooling. The vent/flush line shall run from the seal chamber to the pump discharge.
5. The impeller shall be ASTM B584-836/875 bronze and hydraulically balanced. The impeller shall be dynamically balanced to ANSI Grade G6.3 and shall be fitted to the shaft with a key.
6. The pump shall be fitted with a single mechanical seal, with EPT elastomers and Carbon/Ceramic faces, rated up to 250ºF. This seal must be capable of being flushed externally via a tapping in the pump cover adjacent to the seal cavity. The entire pump line shall use no more than three different sizes of seals.
7. The pump shall be close coupled to a NEMA standard JM frame motor.

B. Vertical In-line Multi-stage Centrifugal Pump

1. The pumps shall be multi-stage vertical design with bowls and impellers designed for removal as a “cartridge”. The capacities and characteristics shall be as called for in the plans/schedules
2. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.
3. All pump bearings shall be lubricated by the pumped liquid.

4. Each pump shall be designed for in-line installation requiring no more than 1.5 square feet of floor space (including motor).
5. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.
6. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor.
7. Motor shall be designed for continuous duty operation, nameplate shall be mounted on enclosure with stainless steel fastening pins, and shall have a NEMA C-Flange for vertical mounting.

2.3 SPARE PARTS

A. Where indicated, the CONTRACTOR shall furnish the required spare parts suitably packaged and labeled with the pump name, location, and identification number. The CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each pump. All spare parts are intended for use by the OWNER, only, after expiration of the guarantee period.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

A. All pumps shall be fitted with a some means of providing pump isolation and check feature for reverse flow. The pump shall be rated for 250 psi working pressure for all jobs. The pump flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class 125 psi flanges or ANSI class 250 flanges. The pump shall include the following components; non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation. Contractor shall install pump in accordance with the manufacturer's instructions. Contractor shall level each pump.

B. Pump shall not be run dry to check rotation.

C. Change start-up strainers to permanent strainer upon acceptance of the job. Provide a blowdown valve on each strainer and terminate with hose thread or extend blowdown line to the nearest floor drain.

END OF SECTION 22 11 23

DIVISION 23

HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Manual gas shutoff valves.
5. Motorized gas valves.
6. Earthquake valves.
7. Pressure regulators.
8. Dielectric unions.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Delegated-Design Submittal: For natural-gas piping and equipment 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. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
2. Service Regulators: 65 psig (450 kPa) minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 0.5 psig (3.45 kPa) or less.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
1. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
2. Coating: PE with flame retardant.

a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

3. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
4. Striker Plates: Steel, designed to protect tubing from penetrations.

5. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
6. Operating-Pressure Rating: 5 psig (34.5 kPa).

C. PE Pipe: ASTM D 2513, SDR 11.

1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.

   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
   b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
   c. Aboveground Portion: PE transition fitting.
   d. Outlet shall be threaded or suitable for welded connection.
   e. Tracer wire connection.
   f. Ultraviolet shield.
   g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

4. Transition Service-Line Risers: Factory fabricated and leak tested.

   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
   b. Outlet shall be threaded or suitable for welded connection.
   c. Bridging sleeve over mechanical coupling.
   d. Factory-connected anode.
   e. Tracer wire connection.
   f. Ultraviolet shield.
   g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches (1830 mm.)

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller.
3. Strainer Screen: [**40**] [**60**]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig (862 kPa)
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
2. Ball: Chrome-plated brass.
3. Stem: Bronze; blowout proof.
4. Seats: Reinforced TFE; blowout proof.
5. Packing: Separate packnut with adjustable-stem packing threaded ends.
6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

7. CWP Rating: 600 psig (4140 kPa).
8. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Bronze Plug Valves: MSS SP-78.
1. Body: Bronze, complying with ASTM B 584.
2. Plug: Bronze.
3. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig (862 kPa).
6. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.6 DIELECTRIC UNIONS

A. Dielectric Unions:
1. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.7 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches (900 mm) below finished grade.

1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Install pressure gage upstream and downstream from each service regulator.

3.2 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Q. Connect branch piping from top or side of horizontal piping.

R. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment.

S. Do not use natural-gas piping as grounding electrode.

T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

U. Install pressure gage upstream and downstream from each line regulator.

V. Install sleeves for piping penetrations of walls, ceilings, and floors.

W. Install sleeve seals for piping penetrations of concrete walls and slabs.

3.3 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameter, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for corrugated stainless-steel tubing, with maximum horizontal spacing and minimum rod diameter, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches (300 mm) of each fitting.

F. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of corrugated stainless-steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

A. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

B. Natural-gas piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be one of the following:

1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
3. Annealed-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.

B. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.10 INDOOR PIPING SCHEDULE

A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be one of the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.11 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, regular-port, bronze ball valves with bronze trim.

3. Bronze plug valve.

B. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, regular-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

C. Valves in branch piping for single appliance shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, regular-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 231123

SECTION 23 30 00 VENTILATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

B. Dampers

C. Fans

1.2 REFERENCES

ASTM A 36 - Structural Steel.

ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.

ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

ASTM A 525 - General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process.

ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.

ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

ASTM C 14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

AWS D9.1 - Welding of Sheet Metal.

NBS PS 15 - Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyestor Chemical Resistant Process Equipment.

NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

NFPA 91 - Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying.

NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

SMACNA - HVAC Air Duct Leakage Test Manual.

SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

SMACNA - Fibrous Glass Duct Construction Standards.

UL 181 - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes 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.

1.4 SUBMITTALS

A. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work.

B. Product Data: Provide data for duct materials.

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

D. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.

E. Shop Drawings: Indicate assembly of fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

F. Product Data: Provide data on equipment fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

1.5 QUALITY ASSURANCE

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

B. Maintain one copy of document on site.

1.6 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A and NFPA 90B and NFPA 96 standards.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealants.

PART 2 - PRODUCTS

2.1 MATERIALS - DUCTS

A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90.

B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.

C. Fasteners: Rivets, bolts, or sheet metal screws.

D. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

E. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 MATERIALS – DUCT INSULATION, FLEXIBLE GLASS FIBER

A. Manufacturers or equal:

1. Owens-Corning.
2. CertainTeed
3. Johns Manville
4. Knauf

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. 'K' ('Ksi') value : ASTM C518, 0.29 at 75 degrees F.
2. Maximum service temperature: 250 degrees F.
3. Density: 1.5lb/cu ft.

C. Vapor Barrier Jacket

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film 0.0032 inch vinyl.
2. Secure with pressure sensitive tape.

D. Vapor Barrier Tape

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Tie Wire: Annealed steel, 16 gage.

2.3 CONTROL DAMPERS

A. Manufacturers or equal:

1. Ruskin
2. Greenheck

B. Multiple Blade Dampers: Fabricate with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.

C. Operators: UL listed and labeled spring return electric type suitable for 120 volts, single phase, 60 Hz. Locate damper operator on exterior of duct and link to damper operating shaft.

2.4 CABINET EXHAUST FAN

A. Cabinet-type ceiling exhaust fans shall be centrifugal type, direct-driven.

B. Housing shall be acoustically insulated, with integral chatter-proof backdraft damper. Furnish unit with mounting flange for securing unit to ceiling framing.

C. The integral face grille shall be of egg-crate design or louver design.

2.5 CHEMICAL ROOM INLINE EXHAUST FAN

A. Housing shall be UV resistant plastic.

B. Assembly to be UL listed with external rotor motor.

PART 3 - EXECUTION

3.1 INSTALLATION - DUCTS

A. Install in accordance with manufacturer's instructions.

B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

D. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

F. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

G. Use double nuts and lock washers on threaded rod supports.

H. Tape joints of PVC coated metal ductwork with PVC tape.

I. Connect diffusers or light troffer boots to low pressure ducts [directly or] with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.

J. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.2 INSTALLATION – DAMPERS

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 15890 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

3.3 INSTALLATION – DUCT INSULATION

A. Install materials in accordance with manufacturer's instructions.

B. Insulated ductwork conveying air below ambient temperature:

1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor barrier jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. For ductwork exposed in mechanical equipment rooms or in finished spaces below 10 feet (3 meters) above finished floor, finish with aluminum jacket.

E. For exterior applications, provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.

F. External Duct Insulation 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 mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

END OF SECTION 23 30 00

SECTION 235123 - GAS VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Listed double-wall vents.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For vents.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of hangers and seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Sample Warranty: For special warranty.

1.4 QUALITY ASSURANCE

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

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents.

B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

A. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F (248 deg C) continuously for Type B or 550 deg F (288 deg C) continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.

B. Construction: Inner shell and outer jacket separated by at least a 1/4-inch (6-mm) airspace.

C. Inner Shell: ASTM B209 (ASTM B209M), Type 1100 aluminum

D. Outer Jacket: Galvanized steel.

E. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.
2. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.
3. Termination: Exit cone with drain section incorporated into riser.
4. Termination: Antibackdraft.

2.2 LISTED TYPE L VENTS

A. Description: Double-wall metal vents tested according to UL 641 and rated for 570 deg F (300 deg C) continuously or 1700 deg F (926 deg C) for 10 minutes; with neutral or negative flue pressure complying with NFPA 211.

B. Construction: Inner shell and outer jacket separated by at least a 2-inch (50-mm) airspace filled with high-temperature, mineral-wool insulation.

C. Inner Shell: ASTM A666, Type 304 stainless steel.

D. Outer Jacket: Galvanized steel.

E. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude 90 percent of rainfall.
2. Termination: Round chimney top designed to exclude 98 percent of rainfall.
3. Termination: Exit cone with drain section incorporated into riser.

PART 3 - EXECUTION

3.1 APPLICATION

A. Listed Type B and BW Vents: Vents for certified gas appliances.

B. Listed Type L Vent: Vents for low-heat appliances.

3.2 INSTALLATION OF LISTED VENTS

A. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Lap joints in direction of flow.

E. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION 235123

SECTION 235533- GAS-FIRED UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes gas-fired unit heaters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of gas-fired unit heater.

1. Include rated capacities, operating characteristics, and accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For gas-fired unit heaters, accessories, and components, from manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace heat exchanger of gas-fired unit heater that fails in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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.

B. Capacities and Characteristics:

1. Gas Input: Per Schedule
2. Gas Output: Per Schedule
3. Motor Enclosure: Totally enclosed, fan cooled.
4. Electrical Characteristics:

a. Motor Size: Per Schedule
b. Motor Speed: 1800 rpm.
c. Volts: 120
d. Phase: Single
e. Hertz: 60.

2.2 MANUFACTURED UNITS

A. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.

B. Gas Type: Design burner for natural gas having characteristics same as those of gas available at Project site.

C. Type of Venting: Indoor, separated combustion, power vented.

D. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.

1. External Casings and Cabinets: Baked enamel or Powder coating over corrosion-resistant-treated surface.
2. Discharge Louvers: Independently adjustable, horizontal blades.

E. Accessories:

1. Four-point suspension kit.
2. Power Venter: Centrifugal aluminized-steel fan, with stainless-steel shaft; 120-V ac motor.
3. Concentric, Terminal Vent Assembly: Combined combustion-air inlet and power-vent outlet with wall or roof caps. Include adapter assembly for connection to inlet and outlet pipes, and flashing for wall or roof penetration.

F. Heat Exchanger: Aluminized steel.

G. Burner Material: Aluminized steel with stainless-steel inserts.

H. Propeller Unit Fan:

1. Formed-steel propeller blades riveted to heavy-gage steel spider bolted to cast-iron hub, dynamically balanced, and resiliently mounted.
2. Fan-Blade Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.

I. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
1. Ignition: Electronically controlled electric spark with flame sensor.

2. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
3. Control transformer.
4. High Limit: Thermal switch or fuse to stop burner.
5. Thermostat: Integral

J. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and connect gas-fired unit heaters and associated gas and vent features and systems according to NFPA 54 applicable local codes and regulations, and manufacturer's written instructions.

3.2 EQUIPMENT MOUNTING

A. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.

B. Substrate-Mounted Units: Provide supports connected to substrate. Secure units to supports.
1. Anchor the unit to resist code-required horizontal acceleration.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to gas-fired unit heater, allow space for service and maintenance.

C. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping. Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.

D. Vent Connections: Comply with Section 235123 "Gas Vents."

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain gas-fired unit heaters.

END OF SECTION 235533

DIVISION 25

INTEGRATED AUTOMATION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 25 14 05 – LOCAL CONTROL STATIONS AND MISCELLANEOUS ELECTRICAL DEVICES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide complete local control stations, relays, detectors, and switches as indicated on the electrical drawings, control diagram, herein, or in other Sections of the Specifications.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Local control panels shall comply with the requirements of the National Electrical Code (NEC), National Electrical Manufacturers Association (NEMA), Local Codes, and shall be built to UL-508 standards, or equal, as approved by the Owner's Representative.

B. Division 26 and Division 40 Specifications.

1.3 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings in accordance with City of Palmer Standard Specifications and Standard Details Specification Section 26 05 00 – Electrical Work, General.

1. Include shop drawings showing panel schematics and layouts, and catalog cuts of all equipment including enclosures, relays, pilot devices, terminations, and wire troughs.

PART 2 - PRODUCTS

2.1 GENERAL

A. The CONTRACTOR shall provide the stations to satisfy the functional requirements in the relevant mechanical equipment and Instrumentation & Control specifications and the Electrical Schematics. Each station shall be fabricated with UL-labeled components. Stations not specifically indicated as being WORK of other Sections shall be provided under this Section. All stations shall be wired under this Section.

B. The controls shall be 120-volt maximum, preferably 24 VDC. Where the electrical power supply is 240-volt, single-phase or 480-volt, 3-phase, the station shall be provided with a fused control power transformer. Control conductors shall be provided in accordance with Section 26 05 00 – Electrical Work, General.

C. Each station shall be provided with identified terminal strips for the connection of external conductors. The CONTRACTOR shall provide sufficient terminal blocks to connect 25 percent

additional conductors for future use. Termination points shall be identified in accordance with Shop Drawings. The stations shall be the source of power for all 24 VDC/120 VAC solenoid valves interconnected with the stations. All equipment associated with the stations shall be ready for service after connection of conductors to equipment, controls, and stations.

D. Wiring to door-mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.

E. Enclosures

1. In indoor dry locations, enclosures shall be NEMA 12 steel enclosures painted ANSI 61 exterior and white interior.

2. In outdoor areas, damp and wet locations, and underground locations, enclosures shall be NEMA 4X stainless steel (prior to modifications) with brushed finish. Where possible, penetrations shall be made in such a manner as to maintain the NEMA 4X rating. If this is not possible, the penetrations shall be made in such a manner as to minimize entry of foreign materials into the enclosure.

3. Through the door disconnects are not permitted.

4. Enclosures shall be freestanding, pedestal-mounted, or equipment skid-mounted, as indicated. Internal control components shall be mounted on a removable mounting pan. Mounting pan shall be finished white.

5. Enclosures shall have non-locking handles.

F. Disconnect Switches

1. Heavy duty, non-fusible, single throw.

2. Horsepower rated.

3. UL listed.

4. Padlockable in "Off" position and door interlock without having the operator mounted on the door.

5. Enclosure per area classification in Section 26 05 00 – Electrical Work, General.

6. 600-volt, 3-phase, 3-pole.

7. Auxiliary control contact as applicable and as indicated.

8. As manufactured by G.E., Cutler-Hammer, or Square D.

G. Identification of panel-mounted devices, conductors, and electrical components shall be in accordance with Section 26 05 00 – Electrical Work, General.

H. Panel-mounted devices shall be mounted a minimum of 3 feet above finished floor elevation.

I. Combination Motor Starters: Provide NEMA combination motor starters not furnished in a new MCC, **Allen-Bradley Bulletin 513**, or equal.

1. Provide circuit breakers. Fuses are not acceptable.

2. Provide overload relay. Overload relay shall be electronic, **Allen-Bradley E3 Plus**, or equal, or thermal overload, as noted on the drawings.

3. Provide terminal strips for field terminations.

4. Provide green run lights.

5. “Through the door” type disconnects are not permitted.

6. Assembly shall be Listed as “Self Protected” under UL 508 Type F.

7. Provide status contact as required by control wiring diagrams.

2.2 STATION COMPONENTS

A. Pushbuttons, selector switches, and pilot lights shall be the heavy-duty, oil-tight type, sized to 30 mm. Miniature style devices are not acceptable. Devices shall be as manufactured by **Square D, G.E., Cutler-Hammer**, or equal. Switches shall be UL listed for use in motor starters, MCCs, or LCPs, as required.

1. Lens colors shall be green for "run," "open," or "on;" red for "stopped," "closed," or "off;" and amber for alarm.

2. Pilot lights shall be LED type.

B. Relays shall be 1, 2, or 3 PDT, as required, with 10-amp contacts, plug-in type utilizing rectangular blades and provided with sockets for screw-type termination and hold-down clips or DIN rail mounted. Relays shall be as manufactured by **Square D, Potter Brumfield**, or equal.

C. Magnetic starters shall be:

1. NEMA rated. IEC or dual NEMA/IEC rated type are not acceptable.

2. FVNR type unless indicated otherwise.

3. Combination starters with magnetic only instantaneous trip circuit breakers such as **Cutler-Hammer “MCP,” G.E., “Mag-Break,”** or equal.

4. Control transformers shall be provided with primary and secondary fuses, 120-volt maximum control voltage.

D. Terminal strips shall be provided for all panels and shall be the flanged fork or ring lug type suitable for No. 12 AWG stranded wire minimum, or shall be DIN rail-mounted terminals, **Phoenix model KDKS**, or equal. Provide 25 percent spare terminals in each panel.

E. Time delay relays shall be combination on delay and off delay (selectable) with adjustable timing ranges. Provide socket with screw terminal connections and retaining strap. Time delay relays shall be Square D JCK70, or equal.

2.3 FACTORY TESTING

A. Each LCS shall be factory-assembled and tested for sequence of operation prior to delivery.

2.4 MISCELLANEOUS DEVICES

A. Heat Detectors:

1. UL Listed, FM Approved.

2. Combination rate-of-rise and fixed, non-plug-in temperature elements with 135 deg. F trip setting.

3. Non-restorable fixed temperature elements and self-restoring rate-of-rise temperature elements.

4. LED indicator for activated rate-of-rise temperature element or activated fixed temperature element.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Stations shall be installed in accordance within Section 26 05 00 – Electrical Work, General, and in accordance with the manufacturer's recommendations.

B. Stations 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. Station interiors and exteriors shall be cleaned, and coatings shall be touched up to match original finish upon completion of the WORK.

D. 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 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 25 14 05

DIVISION 26

ELECTRICAL

THIS PAGE INTENTIONALLY LEFT BLANK

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 Division 26 apply to the WORK of this Section.

C. Equipment specified in other Divisions requiring electrical tests applies to the WORK of this Section.

D. ANSI/NETA ATS Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems (ATS), applies 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 of circuit 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. Compare results with that recommended by ATS; any measurements reading below recommended values shall be submitted to the Engineer for review.

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:

8. Visual and physical check of cables, circuit breakers, transformers and connections associated with each item of new and modified equipment.

9. Circuit breakers that have adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field-adjusted by a representative of the circuit breaker manufacturer. Setting shall be tabulated and proven for each circuit breaker in its installed position. Test results shall be certified by the person performing the tests and be transmitted to the ENGINEER.

10. 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. Provide ground resistance tests on the main grounding bars in all control panels in the presence of the ENGINEER and submit results.

E. Subsystems shall be defined as individual and groups of pumps, conveyor systems, chemical feed pumps, air conditioning units, ventilation fans, air compressors, etc.

F. General: Carry out tests indicated herein for individual items of materials and equipment in other Sections.

G. Megger each complete phase wire, cable, termination, and submersible pump winding to ground. See 1.2 A 5 above and Section 26 05 05 – Electric Motors for additional requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 26 01 26

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 00 – ELECTRICAL WORK, GENERAL

PART 1 - GENERAL

1.1 SCOPE

A. The CONTRACTOR shall provide electrical work, complete and operable, in accordance with the Contract Documents.

B. Provide all labor, products, services, equipment and test equipment required to furnish, install, test and start-up all systems shown and specified

C. 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. Local Conditions: The CONTRACTOR shall thoroughly familiarize himself with the work as well as the local conditions under which the work is to be performed. Schedule work with regard to seasons, weather, climate conditions, and all other local conditions that may affect the progress and quality of work.

E. 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 RELATED WORK - Areas of Responsibility

A. See Divisions 1, which contain information and requirements that apply to work specified herein.

B. The Contractor shall schedule his work to coordinate through the General Contractor and with all other subcontractors, power and telephone utilities in order to maintain job progress and to avoid conflicts with equipment installation or work done by the various trades. It shall be the responsibility of the contractor to provide electrical service to, connection and/or interconnection of various units of equipment supplied by others. The contractor shall not be required to set in place or align motors or devices supplied as an integral part of equipment provided by others. Areas in which the contractor shall coordinate include, but are not limited to, the following:

1. Division 25 Mechanical - The contractor shall provide conduit, wire and necessary appurtenances to connect to the electrical system. All electrically driven, controlled or monitored machinery and equipment installed by others.

2. Division 26 Equipment - The contractor shall provide conduit, wire and necessary appurtenances to connect to the electrical system all electrically driven, controlled or monitored machinery and equipment installed by others.

3. Division 40 Equipment - The contractor shall provide equipment mounting, conduit, wire and necessary appurtenances to connect to the SCADA equipment with the Owner's SCADA contractor's assistance. The following is a list of equipment that will be **Owner Furnished and Contractor Installed (OFCI)**:

Ref	Item	Manufacturer	Part No.
FE-205	Flow Tube	Badger	6" M-2000
FIT-205	Flow Transmitter	Badger	24VDC
FE-221	Flow Element	Badger	1-1/2" M-2000
FIT-221	Flow Transmitter	Badger	24VDC
PIT-200	Pressure Transmitter	Rosemount	2088G4S22A1M4Q4S5
PI-xx	SS gages and fittings for PIT	TPL	
PIT-201	Pressure Transmitter	Rosemount	2088G4S22A1M4Q4S5
PI-xx	SS gages and fittings for PIT	TPL	
LIT-301	Level Transmitter	Rochester	5909S02733
TE-231	Temperature Element	Rosemount	214CRTSMB1S4E0062SLE5UAE030AR1C1B1TBXW
TT-231	Temperature Transmitter	Rosemount	644HAE5J6M5F6Q4
TT-100	Temperature Transmitter	Dwyer	BTT-N00-3
AIT-651	Chlorine Controller/ Analyzer	Hach	SC4500/ CL17SC
FS-651	Flow Switch	McDonnell Miller	FS7-4
FS-652	Flow Switch	McDonnell Miller	FS7-4
LAH-100	Flood switch	Madison	M4301
IP-1/SC-651	Chlorine Feed Pump	Stenner	85MHP17
BS-102A	Smoke Detector	System Sensor	2W-B
BS-102B	Heat Detector	Thermotech	302-ET-135
BS-102C	Heat Detector / Haz Loc	Thermotech	302-EM-135
BATT	Batteries	Powersonic	PS-121100
BATT RACK	Battery Rack	TPL	
SCP	SCADA Panel	TPL	Assembly
RADIO	4.9 GHz Ethernet Radio	Esteem	Horizon 4.9
RADIO	4.9GHz Panel Antenna	Esteem	AA204EP
CAM-1, 2	Interior Cameras	Mobotix	MX-M26
CAM-3,4	Exterior Cameras	Mobotix	MX-Q26
CAM-3,4	Exterior Cameras mounting hood	Mobotix	MX-OPT-WH
CAM-3,4	Exterior Cameras mounting bracket	Mobotix	MX-OPT-AP
NAS	4TB Network accessed storage	Mobotix	MX-S-NAS

C. The contractor shall be responsible for providing, installing and furnishing power to all instrumentation and control devices that are included in Divisions 25, 26.

D. The contractor shall be responsible for installing and furnishing conduit and cabling to all instrumentation and control devices that are included in Divisions 40 work (SCADA control system and instrumentation). Control and instrumentation wiring shall be terminated by the Owner's SCADA contractor. Coordinate all work with SCADA contractor.

1.3 RADIO TOWER

A. The contractor shall be responsible for providing, installing the radio tower (Rohn 45G) and all associated structural elements, bracing and foundations in accordance with the manufacturer's requirements. All work will be coordinated with the Division 26 and 40 contractor.

B. Contractor shall provide design details including structural calculations and drawings stamped, sealed by a professional engineer in the State of Alaska.

1.4 CODES AND 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
NESC	National Electrical Safety Code
IBC	International Building Code

B. 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:

American National Standards Institute - ANSI;
American Society for Testing and Materials - ASTM;
Factory Mutual - FM
Institute of Electrical and Electronics Engineers - IEEE;
National Electrical Contractors Association - NECA;
National Electrical Manufacturers' Association - NEMA;
National Fire Protection Association - NFPA, and
Underwriters Laboratory – UL

C. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards, state building standards, and applicable local codes and regulations.

D. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

E. All electrical work shall be performed by licensed Journeyman Electricians or licensed Apprentice Electricians under the direct supervision of a licensed Journeyman Electrician.

F. Submit written proof of all Journeyman and Apprentice Electricians' current licenses

1.5 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.

1.6 PUBLIC UTILITIES REQUIREMENTS

A. The CONTRACTOR shall contact the serving utility and verify compliance with requirements before construction. The CONTRACTOR shall coordinate schedules and payments for work by all utilities.

B. Electrical service shall be as indicated and be as required by the serving Utility. The electrical power utility for this project is the Matanuska Electric Association (MEA).

C. The CONTRACTOR shall coordinate installation of all electrical service related equipment and shall provide only service equipment that meets the Utilities requirements.

D. The CONTRACTOR shall coordinate with the electric utility to ensure timely application and installation of service. All costs related to service application and installation, including one-time line extension and utility connection costs, shall be paid for by the City of Palmer.

1.7 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 CONTRACTOR shall incur all fees associated with obtained required permits.

C. The CONTRACTOR shall pay all connection and turn-on service charges required by the utility company.

1.8 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance Division 1 Specification Requirements, and the requirements included herein.

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. Operation and Maintenance Manuals:

1. Provide Operation and Maintenance Manuals in the manner described elsewhere in these specifications. In addition, organize manual and include data and narrative as noted below.

2. Provide a separate chapter for each section of the electrical specifications with subchapters for each class of equipment or system. Provide a table of contents for each chapter, and each major item in each chapter, to indicate the page number of each. Label all pages to assure correct placement in manual. Identify each piece of equipment with its associated nameplate number (i.e. pump P-1, etc.).

3. Operating Sequence Narrative:

   a. In each chapter, describe the procedures necessary for personnel to operate the system and equipment covered in that chapter.

   b. Describe procedures for start-up, operation, emergency operation and shutdown of each system. If a particular sequence is required, give step-by-step instructions in that order.

   c. Describe all seasonal adjustments, which should be accomplished for each system.

   d. Provide the above descriptions in typewritten, simple outline, narrative form.

4. Maintenance Instructions:

   a. Provide complete information for preventive maintenance for each product, including recommended frequency of performance for each preventive maintenance task.

   b. Provide all information of a maintenance nature covering warranty items, etc., which have not been discussed in the manufacturer's literature or the operating sequence narrative.

   c. Provide complete informational data for all the spare and replacement parts for each product and system. Properly identify each component by part number and manufacturer.

F. Record Drawings:

1. In addition to other requirements, mark up a clean set of Drawings as the Work progresses, to show the dimensioned location and routing of all electrical Work which will become permanently concealed. Show routing or work in permanently concealed blind spaces within the building. Show complete routing and sizing of any significant revisions to the systems shown.

2. Maintain "As-Built" drawings in an up-to-date fashion in conjunction with the actual progress of installation. "As-Built" progress mark-ups shall be available on-site for examination by the ENGINEER at all times.

3. Provide a final version of the most up-to-date “As-Built” drawings at the close-out phase of the project. The drawings shall clearly identify all changes made to locations of

equipment, circuits and all under slab and underground conduit routing, etc.. Forward to the Engineer a complete set of drawings marked in red pencil in a manner consistent with the Contract Drawings.

G. Equipment Summary Sheets: The CONTRACTOR shall provide Electrical Equipment Summary Forms per ISA for all electrical devices, panels, motor starters, and miscellaneous equipment. The data shall be provided in electronic format, Microsoft Excel, or approved equal.

1.9 AREA DESIGNATIONS

A. General:

1. Raceway systems and enclosures shall comply with Section 26 05 33 – Electrical Raceway Systems.

2. Electrical WORK specifically indicated in sections within any of the Specifications shall comply with those requirements.

3. Electrical WORK in above ground, indoor, dry facilities shall be NEMA 1.

4. Electrical WORK in below ground facilities and outdoors shall be NEMA 4X.

5. Installations in hazardous locations shall conform strictly to the requirements of the Class, Group, and Division indicated.

6. Electrical Work in the Chemical Room shall be considered damp/wet/corrosive and shall be NEMA 4X.

B. Material Requirements:

1. NEMA 4X enclosures shall be stainless steel.

2. NEMA 1 enclosures shall be steel, coated with ANSI 61 grey paint.

1.10 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, 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. Record voltage, current, and megohmeter and ground ohmic resistance test measurements made on the electrical work, the trip units, fuses, and overload relay elements installed in the equipment and the setting of all control devices. When the project is operating, turn over these records to the ENGINEER.

D. Equipment or material which fails a test shall be removed and replaced.

1.11 CONSTRUCTION SEQUENCING

A. Installation of New Equipment:

1. The CONTRACTOR will install and terminate the new switchboards, panelboards, service equipment, motor control centers, 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.

2. The CONTRACTOR shall coordinate with the INTEGRATOR to load and commission the PLC software after the CONTRACTOR makes the wiring modifications.

3. The OWNER shall take beneficial occupancy of the facility as the WORK is signed off.

a. Warranty: The warranty shall start from the date of final acceptance of the completed project and shall extend for 1 year.

1.12 PRODUCTS

A. GENERAL

1. Equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. Equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the WORK shall be products of the same manufacturer. Equipment and materials shall be of industrial grade standard of construction.

2. 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.

3. On devices indicated to display dates, the year shall be displayed as 4 digits.

B. MOUNTING HARDWARE

C. 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.

1.13 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.

PART 2 - EXECUTION

2.1 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, 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 1/2-inch minimum. Where circuits are combined in the same raceway, the CONTRACTOR shall derate conductor ampacities in accordance with NEC requirements.

4. Contractor shall submit an under slab and underground raceway plan for approval. Intent is to minimize number of raceway systems.

C. Workmanship: Materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the work. Installation shall be coordinated in the field with other trades to avoid interferences.

D. Protection of Equipment and Materials: The CONTRACTOR shall fully protect materials and equipment against damage from any cause. Materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry. The CONTRACTOR shall replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections, as part of the WORK.

E. Incoming utility power equipment shall be provided in conformance with the utility's requirements and shall be listed as service entrance.

2.2 CONNECTIONS TO EQUIPMENT

A. Provide electrical connections to equipment provided under various sections of these

B. Specifications. Equipment shall be wired complete in each detail, including interlocks, safety disconnects, control devices, starters, and disconnects.

C. Drawings indicate equipment as anticipated to be furnished. If equipment differing from that indicated is furnished, the furnished equipment shall be wired completely as required at no additional cost to the OWNER.

D. Connections and wiring diagrams shown on the drawings are for bidding purposes only. The CONTRACTOR shall obtain final wiring diagrams specifically for the equipment furnished from equipment suppliers.

E. Motor sizes shown on the Drawings are for bidding purposes only. The CONTRACTOR shall verify all motor sizes prior to wiring and shall provide proper motor starters, overcurrent protection, feeders and conduit for the equipment furnished at no additional cost to the OWNER.

Conduit and wire are shown on the drawings for bidding purposes only. The CONTRACTOR shall verify wire sizes and number of wires required, and provide the proper conduit and wire to each item of equipment at no additional cost to the OWNER.

1.1 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.

1.2 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 3-1/2 inches above finished floor or grade; if adjacent an equipment housekeeping pad, housekeeping curbs shall match the height of the equipment housekeeping pad.

1.3 EQUIPMENT ANCHORING

A. Floor supported, wall-, or ceiling-hung equipment and conductors shall be anchored in place by methods that will meet seismic requirements in the area where the project is located. Wall-mounted panels that weigh more than 500 pounds, or which are within 18 inches of the floor, shall be provided with fabricated steel 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 Division 01 Requirements.

C. Panels, raceways, and other equipment shall be anchored and supported for Seismic requirements of the area installed.

1.4 EQUIPMENT IDENTIFICATION

A. General: Equipment and devices shall be identified as follows:

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

1.5 CLEANING

A. Before final acceptance, the electrical WORK shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. Oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners cleaned out. Touch-up paint shall be applied to scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum-cleaned.

B. CONTRACTOR shall group, coil, and tie wrap all spare cables at the bottom of the Local Control Panels. The wires shall be grouped according to the device or control panel 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.

1.6 INSTRUCTION OF OPERATING PERSONNEL

F. After the system is complete and prior to final acceptance, instruct designated personnel of the OWNER on the proper operation and maintenance of all electrical systems and equipment under this contract. This instruction shall be independent of other activities and shall <u>not</u> coincide with any start-up or testing procedures. In addition, a qualified representative of each system listed below shall instruct the designated personnel in the operation and maintenance of the associated system. Give these operating instructions after the operation and maintenance manuals have been furnished to the OWNER. Submit written certification, signed by the CONTRACTOR and an authorized representative of the OWNER, that this has been completed. This requirement shall be in addition to any others defined under this contract.

1. Coordinate with the Owner a minimum of two weeks in advance to set a mutually agreeable time to provide instruction for the following systems for at least the number of hours indicated:

System or Equipment	Hours of Instruction
ATS	2
Variable Frequency Drives	2
Standby Generator	4

2. Certify that local authorized service organization regularly carries complete stock of repair parts for listed equipment or systems, that organization is available and will furnish service within 48 hours after request. Include name, address, and telephone number.
3. Have approved operating and maintenance data, and parts lists for all equipment on hand at the time of instruction.

1.7 PROJECT COMPLETION AND DEMONSTRATION

G. During final inspection, conduct operating tests for approval. Demonstrate to the Owner that the electrical installation is working by operating all electrical systems and equipment. Simulate control, standby and alarm conditions, artificially where necessary, for complete system tests.

H. Have instruments available for measuring voltage and current values and for demonstration of continuity, ground, or open circuit conditions. Furnish personnel for taking measurements and making tests.

I. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents. Should a portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply. Correct all shorts, open circuits, and unintentional grounds. In the event that systems are not complete and fully operational at the time of Final Inspection, all costs of any subsequent inspections, rework or repair of equipment required during or as a result of the testing, shall be borne by the CONTRACTOR at no additional cost to the OWNER.

J. Thirty days prior to testing, submit to the engineer a Coordinated Test Plan and detailed Test Procedures, for review and approval. All testing shall be conducted in accordance with the manufacturer's installation and testing instructions and the applicable electrical standards (i.e., NEMA, IEEE, ISA, ANSI, or other) for the class of equipment.
   a. The Test Plan shall outline the tests planned for each item of equipment. The Test Procedures shall identify the test equipment to be utilized, the action of each test step and the expected result so that a test technician who has no knowledge of the details of the equipment design shall be able to successfully conduct the test.
   b. Request For Tests: Notify the ENGINEER a minimum of 48 hours in advance of tests. In the event the ENGINEER does not witness the test, certify in writing that all specified tests have been made in accordance with the Specifications.
   c. Test and document (on test forms) the equipment and electrical circuits for proper connection, continuity, and absence of undesirable shorts and grounds. Test wire and cable installation, when complete and 72 hours prior to energizing the system. Check for continuity, visual damage, marking, and proper phase sequence before performing insulation testing. Megger bus work, switches, breakers and circuits phase-to-phase and phase-to-ground. Disconnect and re-connect equipment, which

cannot be meggered otherwise. The minimum acceptable steady-state value is 50 megohms. Ambient temperature and humidity during testing shall be recorded.

d. Perform a voltage test at the last outlet or load on each circuit with the design load, or its equivalent, in operation. If the drop in potential is excessive (>5%), locate the point of trouble and correct the condition.

e. Test insulation resistances of all motor windings to ground with a Megger, before applying line voltage to the motors. If test values are less than 5 megohms, repair or replace the motor.

f. Measure line-to-line voltage and line current of all motors, with system energized. If the measured values are not acceptably close, in the opinion of the ENGINEER, to the nameplate rating of the motors, correct the condition causing the deficiency.

g. Check voltage and phasing of service tie connections at switchboards. Phasing shall be maintained ABC top to bottom, left to right, and front to back.

h. Check each component of the complete system for proper performance of its intended function.

i. Test electrical equipment, including the motor generator transfer switch system, before it is energized and placed in service.

j. Verify operation, calibration, and settings of the meters, relays and indicating devices.

k. Check all auxiliary equipment, i.e., heaters, thermostats, lights, and all illuminated indicating devices and lamps, and all audible alarm devices to verify that they function properly.

l. Overload heaters shall be checked and the size on each phase shall be noted at this time on the test sheet.

m. Report all test results in writing. Where tests disclose problem areas, retest after the defect has been corrected.

n. Operate the electrical systems until acceptance of the work. The Contractor shall instruct Owner's employees in the correct operation of all electrical and control systems under the contractor's jurisdiction.

o. The Contractor shall furnish to the Owner at the time the project is accepted, any special tools, calibration equipment, and testing apparatus specified or furnished by the equipment manufacturer for the proper adjustment and maintenance of the electrical equipment provided.

p. Testing for equipment under Division 26 must be completed prior to any pre-commissioning testing as required under Division 40 for controls for that equipment.

q. Certificate of Completion

Submit, at time of request for Final Inspection, a completed letter in the following format:

I,_____(Name), of _____(Firm), certify that the Electrical Work is complete in accordance with Contract Plans and Specifications, and authorized change orders (copies of which are attached hereto), and will be ready for Final Inspection as of _____(Date). I further certify that the following Specification requirements have been fulfilled:

1) Megger readings performed, ____ copies of log attached.

2) Operating manuals completed and instructions of operating personnel performed _____(Date)_____ (Signed)

ENGINEER

3) As-Built Drawings up-to-date and ready to deliver to ENGINEER.
4) Emergency systems tested and fully operational.
5) All other tests required by Specifications have been performed.
6) All systems are fully operational. Project is ready for Final Inspection.

SIGNED:_____ DATE:_____

TITLE:_____

END OF SECTION 26 05 00

THIS PAGE INTENTIONALLY LEFT BLANK

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 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. General: Submittals shall be in accordance with Division 01 specification requirements and Section 26 05 00 – Electrical Work, General.

B. Complete motor data shall be submitted. Motor data shall include:

1. Motor manufacturer.
2. Motor type or model and dimension drawing. Include motor weight.
3. Nominal horsepower.
4. NEMA design.
5. Enclosure.
6. Frame size.
7. Winding insulation class and temperature rise class.
8. Voltage, phase, and frequency ratings.
9. Service factor.
10. Full load current at rated horsepower for application voltage.
11. Full load speed.
12. Torque characteristics.
13. Guaranteed minimum full load efficiency. Also nominal efficiencies at 1/2 and 3/4 load.

14. Type of thermal protection or overtemperature protection, if included.

15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable.

16. Bearing data. Include recommendation for lubricants of 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/control 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 pre-calibrated by the manufacturer.

2.4 MOTOR BEARINGS

A. Motors shall have bearings designed for 100,000 hours (coupled) L-10 life.

B. Motors that are indirectly coupled and are controlled by VFD's shall have provisions to limit bearing currents. Provisions as a minimum shall be **AEGIS SGR Bearing Protection Ring**, or an approved equal. It is the responsibility of the Contractor to coordinate and select the appropriate size bearing protection ring for the specific piece of equipment to be protected.

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 motors in accordance with NEMA MG-1. Test voltage shall be 1000 VDC minimum, or as otherwise recommended in NEMA MG-1.

END OF SECTION 26 05 05

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 19 – WIRE AND CABLE

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide wires and cable, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit Product Data and Shop Drawings in accordance with requirements specified in the Division 01 Specifications and 26 05 00 – Electrical Work, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. Conductors, including grounding and bonding 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 Electrical Code (NEC), 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, 600V rated.
2. Wire rated for 600 volts in duct or conduit for all power shall be
3. In above grade interior locations: Class B Type THWN-2
4. In underground and below grade installations XHHW-2
5. Direct burial shall use XLPE outer jacketed cable.
6. Wiring for 600 volt class power and lighting shall be as manufactured by **General Cable**, **Okonite**, or **Rome Cable**.

B. Control Wire

1. Control wire in duct or conduit shall be the same type as power and lighting wire indicated above.

2. Control wiring shall be No.14 19-strand copper AWG.

C. Instrumentation Cable

1. Instrumentation cable shall be rated at 600 volts.

2. Individual conductors shall be No. 18 AWG stranded, tinned copper. Insulation shall be color-coded polyethylene: black-red for two-conductor cable, and black-red-white for three-conductor cable.

3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 18 AWG stranded, tinned copper drain wire, and a PVC outer jacket with a thickness of 0.048-inches.

4. Single pair, No. 18 AWG, twisted, shielded cable shall be **Belden Part No. 9341**, or equal.

5. Single triad, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 1119A**, or equal.

D. Tray Cable - Tray cable is not to be used.

E. Cat 6A Cable: Cat 6A patch cable shall be 4-pair 24-gauge twisted pair rated to TIA/EIA 568-D Cat. 6A and UL-listed. The CONTRACTOR shall install RJ-45 connectors as required.

F. VFD motor circuit cable: Motors circuits operated under VFD control shall be run with shielded cable. Cable shall be **Belden 295xx** (where xx= wire gauge) or VFD Manufacturer recommended equal. Twisted shielded THHN is not permitted.

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.

PART 3 - EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall provide and terminate all power, control, and instrumentation conductors, except where indicated.

3.2 INSTALLATION

A. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 2 percent at the farthest 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.

4. Exception: Where equipment only accommodates a single conduit connection, circuits may be combined in a single raceway not exceeding 12” total length.

F. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps, and shall be fanned out to terminals.

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. 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.

3. 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.

3.4 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, bus bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, left to right, facing towards the front of equipment.

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 Division 01 and 26 – 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 a ground using a megohmeter.

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 26 05 19

SECTION 26 05 26 – GROUNDING

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide the electrical grounding system, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 26 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 Division 01 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.

1.3 REFERENCE STANDARDS

A. National Electrical Code (NEC), Latest adopted edition

PART 2 - PRODUCTS

2.1 GENERAL

A. Components of the grounding electrode system shall be manufactured in accordance with ANSI/UL 467 - Standard for Safety Grounding and Bonding Equipment, and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

2.2 GROUNDING SYSTEM

A. Grounding loop conductors shall be bare annealed copper conductors suitable for direct burial. Conductors shall be No. 4 for 100A services, or 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. Buried cable-to-cable and cable-to-ground rod connections shall be made using exothermic welds by **Cadweld, Enrico Products**, or equal.

D. Exposed grounding connectors shall be of the compression type (connector to cable), made of high copper alloy, and be manufactured specifically for the particular grounding application. The connectors shall be **Burndy, O.Z. Gedney**, or equal.

E. Grounding clamps shall be used to bond each separately derived system to the grounding electrode conductors.

F. Equipment Grounding Circuit Conductors

1. These conductors shall be the same type and insulation as the load circuit conductors. The minimum size shall be as outlined in Table 250.122 of the National Electrical Code, unless indicated otherwise.

2. Metallic conduit systems shall have equipment grounding wires as well as being equipment grounding conductors themselves.

G. Ground clamps in concrete shall be rated for use with rebar and embedded in concrete.

H. Manufacturers of grounding materials shall be **Copperweld, Blackburn, Burndy**, or equal.

PART 3 - EXECUTION

3.1 GROUNDING

A. Provide a separate grounding conductor, securely grounded in each raceway independent of raceway material.

B. Provide a separate grounding conductor for each motor and connect at motor box. Do not use bolts securing motor box to frame or cover for grounding connectors.

C. Size in accordance with the NEC-Article 250 and local amendments.

D. Route conductors inside raceway.

E. Provide a grounding type bushing for secondary feeder conduits which originate from the secondary section of each MCC section, switchboard, or panelboard.

1. Individually bond these raceways to the ground bus in the secondary section.

F. 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.

G. Provide a separate grounding conductor in each individual raceway for parallel feeders.

H. Interconnect the secondary switchgear neutral bus to the ground bus in the secondary switchgear compartment only at service entrance point or after a transformer.

I. Bond cold water pipe systems and metallic building structure per NEC. Bond ALL water pipe penetrations.

J. Measure ground impedance in accordance with IEEE STD 81 after installation but before connecting the electrode to the remaining grounding system.

K. 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.

L. 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.

4. The CONTRACTOR shall provide concrete encased electrodes where called for on the Plans.

M. 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, or as shown on the plans.

N. 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.

END OF SECTION 26 05 26

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. This project has special requirements in addition to the NEC in regard to equipment grounding conductors:

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 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.

c. This equipment grounding conductor is in addition to metallic raceway meeting the standard NEC requirement of an EGC.

C. Provide Product Data and Shop Drawing submittals in accordance with Division 01 Specifications and Section 26 05 00 – Electrical Work, General requirements.

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 exterior locations unless noted otherwise.

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 under or in slabs, for slab penetrations up to 12” above finished floor and within chemical treatment rooms.

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. Intermediate conduit (IMC) may be used in the pump room.

1. IMC shall be hot-dip galvanized, and UL listed.

2. IMC shall be installed with five full engaged threads.

3. IMC threads shall be factory cut. Field cut threads shall be applied with equal or greater galvanized coating to that of the factory threads prior to installation.

2.3 FITTINGS AND BOXES

A. General:

1. Cast and malleable iron fittings for use with metallic conduit shall be the threaded type with 5 full threads.

2. 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.

3. Non-explosion-proof boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.

4. Boxes larger than standard cast or malleable types shall be 304 stainless steel, NEMA 4X.

5. 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.

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. Cable trays are not to be used.

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.

PART 3 - EXECUTION

3.1 GENERAL

A. All wiring shall be run in raceway unless indicated otherwise.

B. Raceways shall be installed between all equipment, whether or not specifically 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 shall be utilized on raceways over 2". All fittings and connections shall be made tight with five full threads engaged, minimum.

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

When non-loop powered instruments have only one raceway port, the CONTRACTOR may run both the analog and 24 VDC wiring in a short length of ½" LFMC to a splitter box where the wiring must then be separated into the required raceway system. The length of LFMC must be kept to the absolute minimum and must not exceed 3 feet unless written approval has been given by the ENGINEER.

D. 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 Paragraph B for additional installation requirements.

E. 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.

F. Support rod attachment for ceiling-hung trapeze installations shall meet the seismic requirements.

G. Exposed raceways shall be installed parallel or perpendicular to structural beams.

H. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.

I. 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.

J. In underground facilities or NEMA 4X areas, all raceway penetrations in panels shall be bottom entry.

K. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, suitable insulating means shall be provided to prevent such corrosion.

L. 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.

M. 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 galvanized steel intermediate metallic conduit except as follows, unless indicated otherwise:

1. In outdoor areas, all underground vaults, and NEMA 4X areas, galvanized rigid steel conduit (GRC) shall be utilized.

B. Exposed conduit shall be 3/4-inch minimum trade size. Supports shall be installed at distances required by the NEC.

C. Conduit shall not be encased in the bottom floor slab below grade.

D. Raceways passing through a slab, wall, or beam shall not impair significantly the strength of the construction.

E. 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.

F. Raceways shall be placed so that cutting, bending, or displacing reinforcement from its proper location will not be required.

G. Threads shall be factory galvanized. Field-cut threads shall be coated with a manufacturer recommended corrosion inhibiting lubricant.

H. 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.

I. 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.

J. 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.

K. Raceways passing through walls or floors shall have plastic sleeves. Core drilling shall be performed in accordance with Section 26 05 00.

L. Provide raceway seal fittings at the following locations:

1. In hazardous classified locations, in strict accordance with the NEC.

M. 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.

N. 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.

O. 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.

P. 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.

Q. Connections to solenoid valves, pilot actuators, and flood sensors shall be made with LFMC and approved fittings to a cast box with screw cover (GUA type), independently and securely supported. In no case is the device to support the cast box.

3.3 CABLE TRAYS

A. Cable trays are not to be used.

END OF SECTION 26 05 33

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 Division 01 Specification Requirements 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 nameplate ratings, including:

1) Voltage

2) Continuous current

3) Basic impulse level for equipment over 600 volts

4) kVA

5) Impedance

6) Time-current characteristic curves with transformer damage curves

7) Efficiency at 0, 1/4, 1/2, 3/4, and Full Rated Load.

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.

3. Transformers shall be manufactured by a company experienced in the design and construction of NEMA rated transformers for at least five years.

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 **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 26 22 00.05

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide panelboards complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 CONTRACTOR SUBMITTALS

A. General: Submittals shall be in accordance with Division 01 specification requirements 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. Trip
   b. Interrupting
   c. Voltage
   d. 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 on the plans.

2. Panelboards rated 480 VAC shall have short circuit ratings not less than 65,000 amps RMS symmetrical or as indicated on the plans.

3. Panelboards shall be labeled with a UL ampere interrupting rating. Series ratings are not acceptable.

4. Service entrance panelboards (panels connected to transfer switches or power meters) rated 240 VAC or less shall have short-circuit rating not less than 22,000 amps RMS symmetrical.

5. 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. Breakers shall be of the bolt-on type.

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 manufactured by **Square D / Scheider Electric**.

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 NEC.

PART 3 - EXECUTION

A. GENERAL

B. All WORK of this Section shall be installed as indicated in Section 26 05 00 – Electrical Work, General.

END OF SECTION 26 24 16

THIS PAGE INTENTIONALLY LEFT BLANK

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 City of Palmer Standard Specification Requirements and Section 26 05 00.

B. Shop Drawings

1. Complete catalog cuts of switches, receptacles, enclosures, covers, and appurtenances, marked to clearly identify proposed materials.

2. Documentation showing that proposed materials comply with the requirements of NEC and UL.

3. Documentation of the manufacturer's qualifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. All devices shall carry the UL label.

B. General purpose duplex receptacles and toggle switch handles shall be brown everywhere except in finished rooms where they shall be ivory. Special purpose receptacles shall have a body color as indicated. Receptacles and switches shall conform to Federal Specifications W-C-596E and W-S-896E, respectively.

2.2 LIGHTING SWITCHES

A. Local branch switches shall be toggle type, rated at 20 amps, 120-277 VAC, and shall be **General Electric Cat. No. GE-5951-1** for single pole, **GE-5953-1** for 3-way and **GE-5954-1** for 4-way, or similar types as manufactured by **Hubbell**, or equal.

2.3 GENERAL PURPOSE RECEPTACLES

A. Duplex receptacles rated 120-volt, 20 amps shall be polarized 3-wire type for use with 3-wire cord with grounded lead and 1 designated stud shall be permanently grounded to the conduit system (NEMA 5-20R). Duplex 120-volt receptacles shall be **G.E. 5362, Hubbell 5362**, or equal. 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. Where called for on the Plans, locking receptacles shall meet the following minimum requirements. 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 Weather Resistant type, 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 Article 250, and Section 26 05 26 – Grounding.

B. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.

C. Ground flush receptacles and their metal plates through positive ground connections to outlet box and grounding system. Maintain ground to each receptacle by spring-loaded grounding contact to mounting screw or by grounding jumper, each making positive connection to outlet box and grounding system at all times.

3.3 FIELD TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 26 05 00 – Electrical Work, General.

B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.

END OF SECTION 26 27 26

SECTION 26 29 23 – 480V VARIABLE FREQUENCY DRIVE UNITS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General: 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 operation.

B. The requirements of Section 26 05 00 – Electrical Work, General, apply to the WORK of this Section.

C. Single Manufacturer: Like products shall be the end product of one manufacturer in order to standardize appearance, operation, maintenance, spare parts, and manufacturer's services. This requirement, however, does not relieve the CONTRACTOR of overall responsibility for the WORK.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Division 01 Requirements and Section 26 05 00.

B. Shop Drawings: Shop Drawings shall include the following information:

1. Elevation Drawings: Include dimensional information and conduit routing locations.

2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, etc. as required for approval.

3. Wiring Diagrams:

    1. Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, etc. as required for approval.

    2. Control Diagram: Include disconnect devices, pilot devices, etc.

4. Major components list.

5. Equipment information

    1. Name of drive manufacturer

    2. Type and model with complete catalog number and explanation

    3. Assembly drawing and nomenclature

    4. Maximum heat dissipation capacity in kW

6. Enclosure rating.

7. Operator interface information

C. Product Data Sheets

1. VFD and Operator Interface publications.

2. Data sheets and publications on all major components including but not limited to the following:

1. Contactors

2. Circuit breaker and fuses (power and control)

3. Control power transformers

4. Pilot devices

5. Relays/Timers

D. Test procedures shall be per the manufacturer's standards.

E. The Technical Manual shall contain the following documentation:

1. Manufacturer's 2 year warranty.

2. Field test report.

3. Programming procedure and program settings.

F. Spare Parts List: Information for parts required by this Section plus any other spare parts recommended by the controller manufacturer.

1.3 CLOSEOUT SUBMITTALS (OPERATION AND MAINTENANCE MANUALS)

A. Submit under provisions of Division 01 Specifications and Section 26 05 00 – Electrical Work, General.

B. Shop Drawings – Final as shipped

1. Elevation Drawings: Include dimensional information and conduit routing locations.

2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, etc. as required for approval.

3. Wiring Diagrams:

1. Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, etc. as required for approval.

2. Control Diagram: Include disconnect devices, pilot devices, remote devices, etc.

4. Major components list.

C. Product Data Sheets

1. VFD and Operator Interface publications.

2. Data sheets and publications on all major components including but not limited to the following:

1. Contactors

2. Circuit breaker and fuses (power and control)

3. Control power transformers

4. Pilot devices

5. Relays/Timers

D. Test procedures shall be per the manufacturer’s standards.

E. Operation and Maintenance Data

1. Service and Contact information

2. Manufacturer's 2 year warranty.

3. Field test report.

4. Programming procedure and program settings

5. VFD and Operator Interface User Manuals

6. Troubleshooting / Service Manuals

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers:

1. The VFD and all associated optional equipment shall be UL listed or recognized.

2. The VFD shall contain a UL label attached on the inside of the enclosure cabinet.

2. Suppliers:

1. All inspection and testing procedures shall be developed and controlled under the guidelines of the Supplier's quality system and must be registered to ISO 9001 and regularly reviewed and audited by a third party registrar.

2. The VFD shall be factory pre-wired, assembled and tested as a complete package.

3. Manufacturer: Allen-Bradley, ABB, or equal.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall coordinate the shipping of equipment with the manufacturer.

B. Contractor shall store the equipment in a clean and dry space at an ambient temperature range of -25 °C to 55 °C (-13 °F to 130 °F).

C. The contractor shall protect the units from dirt, water, construction debris and traffic.

PART 2 - PRODUCTS

2.1 GENERAL

A. The CONTRACTOR shall provide variable frequency drives for the following centrifugal pumps:

Facility	Equipment	Enclosure	Pump HP	Drawing
Booster Station	P-1	NEMA 1	1.5	
Booster Station	P-2	NEMA 1	20	
Booster Station	P-3	NEMA 1	20	
Booster Station	P-4	NEMA 1	75	

B. The CONTRACTOR shall provide variable frequency drives as shown on the Drawings.

2.2 VFD UNIT

A. Adjustable frequency inverters shall be

1. Designed to operate at 480V 3 phase or convert incoming 1-phase, 480 volt, 60 Hertz power to a DC voltage and then to adjustable frequency 3-phase AC by use of a 3 phase inverter as shown on the drawings.

2. The inverter shall be a voltage source design producing a pulse-width-modulated type output.

3. Inverters shall be 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 de-rating (other than for single phase source) or requiring any motor modifications.

4. Inverters shall be capable of delivering nameplate horsepower exclusive of service factor without the need for mandatory thermostats or feedback tachometers.

5. The VFD shall vary both the AC voltage and frequency simultaneously to operate the motor at required speeds.

6. Current source inverters will not be acceptable.

7. Inverters shall be sized to match the KVA and inrush characteristics of the motors.

B. The CONTRACTOR shall be responsible for matching the controller to the load (variable torque) as well as the speed and current of the actual motor being controlled, including over-sizing of the drive for the single-phase input.

C. Hardware

1. Incorporate phase to phase and phase to ground MOV protection on the AC input line.

2. Microprocessor based inverter logic shall be isolated from power circuits.

3. Utilize latest generation IGBT inverter section.

4. Battery receptacle for Lithium battery power to the Real Time Clock.

5. Additional DPI port for handheld and remote HIM options.

6. Optional onboard 24V DC Auxiliary Control Power Supply.

D. Control Logic

1. Ability to operate with motor disconnected.

2. Provide a controlled shut down, 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.

3. Provide multiple programmable stop modes including Ramp, Coast, DC-Brake, Ramp-to-Hold, Fast Braking, and Current Limit Stop.

4. Provide multiple acceleration and deceleration rates.

5. Adjustable output frequency up to 650Hz.

E. DeviceLogix Control

1. Ability to control outputs and manage status information locally within the VFD.

2. Ability to function stand-alone or complimentary to supervisory control.

3. Ability to speed reaction time by processing in the VFD.

4. Ability to provide scaling, selector switches, or other data manipulations not already built into the VFD.

5. Ability to read inputs/write outputs and exclusively control the VFD.

6. Ability to provide an option for decision making if communication is lost with main controller.

7. Ability to control other VFDs via a peer-to-peer EtherNet/IP network.

8. Ability to write programs off-line.

F. Motor Control Modes

1. Selectable Sensorless Vector, Flux Vector, V/Hz, and Adjustable Voltage Control modes selectable through programming.

2. The V/Hz mode shall be programmable for fan curve or full custom patterns.

3. Capable of Open Loop V/Hz.

G. Current Limit

1. Programmable current limit from 20 to 160% of rated output current.

2. Current limit shall be active for all drive states: accelerating, constant speed and decelerating.

H. Acceleration / Deceleration

1. Accel/Decel settings shall provide separate adjustments to allow either setting to be adjusted from 0 to 3600 seconds.

I. Speed Profiles

1. Programming capability shall allow the user to produce speed profiles with linear acceleration/deceleration or "S Curve" profiles that provide changing accel/decel rates.

2. S Curve profiles shall be adjustable.

J. Adjustments

1. A digital interface can be used for all set-up, operation and adjustment settings.

2. All adjustments shall be stored in nonvolatile memory (EEPROM).

3. No potentiometer adjustments shall be required.

4. EEPROM memory for factory default values shall be provided.

5. Software must be available for trending and diagnostics, as well as online and offline programming functionality.

K. Skip Frequencies

1. Three adjustable set points that lock out continuous operation at frequencies which may produce mechanical resonance shall be provided.

2. The set points shall have a bandwidth adjustable from Maximum Reverse Speed to Maximum Forward Speed.

L. Fault Reset / Run

1. The drive shall provide up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart.

2. The automatic mode shall not be applicable to a ground fault, shorted output faults and other internal microprocessor faults.

3. The time between restarts shall be adjustable from 0.5 seconds to 30 seconds.

M. Fault Memory

1. The last 32 fault codes shall be stored and time stamped in a fault buffer.

2. Information about the drive's condition at the time of the last fault such as operating frequency, output current, dc bus voltage and twenty-seven other status conditions shall be stored.

3. A power-up marker shall be provided at each power-up time to aid in analyzing fault data.

4. The last 32 alarm codes shall be stored and time stamped for additional troubleshooting reference.

N. Overload Protection

1. The drive shall provide internal class 10 adjustable overload protection.

2. Overload protection shall be speed sensitive and adjustable.

3. A viewable parameter shall store the overload usage.

O. Terminal Blocks

1. Separate terminal blocks shall be provided for control and power wiring.

2. I/O terminal blocks shall be removable with wiring in place.

P. Flying Start

1. The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick-up" the motor at the rotating speed. This feature is disabled by default.

Q. Ethernet/IP Interface: The inverter signal circuits shall be isolated from the power circuits and be designed to accept a Ethernet/IP interface. The drive automatically communicates with ABB programming software to address the drive upon Ethernet/IP connection. The inverter shall follow the setting of a local control when in the hand mode. The following operator monitoring and control devices for the inverter shall be provided on the face of the VFD enclosure, either as discrete devices, or as part of a multi-function microprocessor-based keypad access device. Access to set-up and protective adjustments shall be protected by key-lockout or password.
   1. All available programming parameters must be addressable from the Ethernet/IP network without the use of protocol convertors or bridges.
   2. Auto/Hand selection from the operator interface. In "Auto", the inverter shall operate from the Ethernet/IP input, and in "Hand" control, shall operate on ethernet/IP from the local keypad.
   3. Speed indicator calibrated in percent speed
   4. Inverter fault trip indication and output alarm contact.
   5. Trip reset pushbutton

R. Electronic overload protection.
   1. Properly identified screw type terminal boards shall be provided for interconnection to remote controls. Factory wiring to terminal boards shall be provided.

S. I/O Option Module: The CONTRACTOR shall provide a 24vdc I/O Module with the following features:
   1. Compatible with the VFD specified herein
   2. Two (2) analog inputs
   3. Two (2) analog outputs
   4. Six (6) discrete inputs
   5. Two (2) relay outputs
   6. No jumpers or switches shall be required to configure the digital inputs and outputs
   7. I/O Options Modules shall be Allen-Bradley PF750 24V I/O Module Cat No. 20-750-2262C-2R
   8. I/O Option Module shall be factory wired to a terminal strip within the VFD/MCC enclosure for field wiring to remote devices.

T. Reference Signals
   1. The drive shall be capable of using the following input reference signals:

1) Station PLC via Ethernet/IP

2) Analog inputs

3) Preset speeds

4) Digital MOP

5) Human Interface Module (HIM)

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 the following:

1) Fault the drive and coast to stop.

2) Issue a minor fault - allows the drive to continue running while some types of faults are present.

3) 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:

1) Fault

2) Stop

3) Zero Data

4) Hold Last State

5) Send Fault Configuration

4. Metering

At a minimum, the following parameters shall be accessible through the Human Interface Module, if installed:

1) Output Current in Amps

2) Output Voltage in Volts

3) Output Power in kW

4) Elapsed MWh

5) DC Bus Voltage

6) Frequency

7) Heatsink Temperature

8) Last eight (32) faults

9) Elapsed Run Time

10) IGBT Temperature

5. Faults

At a minimum, the following faults shall be accessible through the Human Interface Module:

1) Power Loss

2) Undervoltage

3) Overvoltage

4) Motor Overload

5) Heat Sink Over-temperature

6) Maximum Retries

7) Phase to Phase and Phase to Ground Faults

6. Predictive Diagnostics

At a minimum, the following predictive diagnostic features shall be provided:

1) Relay Output Life Cycles based on load type and amps.

2) Hours of Fan Life based on load and ambient temperature.

3) Motor Bearing life based on expected hours of use.

4) Motor Lubrication schedule based on hours of use.

5) Machine Bearing life based on expected hours of use.

7. Real-Time Clock

1) Shall be capable of providing time stamped events.
2) Shall have the ability to be set locally or via a remote controller.
3) Shall provide the ability to be programmable for month, day, year and local time zones in HH:MM:SS.

U. NEMA 1 Enclosure: Drives designated as NEMA 1 shall have a wall-mounted IP66-rated NEMA 1 integral enclosure with external heat sink for installation without the use of a separate enclosure. Drives designated for installation within motor control centers shall be listed for installation in motor control centers.

V. The minimum VFD inverter efficiency shall be 95 percent at 100 percent speed and load, and 85 percent at 50 percent speed and load.

W. 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.

X. The VFD shall be provided with additional features described below:

1. Inrush current adjustment between 50 and 110 percent of motor full load current (factory set at 100 percent).

2. Overload capability at 110 percent for 60 seconds for variable torque loads.

3. Adjustable acceleration and deceleration.

4. On loss of input signal, the VFD shall operate at a preset speed or hold last state at time of signal loss.

5. A minimum of 2 selectable frequency jump points to avoid critical resonance frequency of the driven system.

6. 3 percent line reactor on the output when indicated on the drawings.

Y. Protection: The VFD shall have, as a minimum, the following protection features:

1. Input line protection provided with metal oxide varistor (MOV) and RC network.

2. Protection against single phasing.

3. Instantaneous overcurrent protection.

4. Electronic overcurrent protection.

5. Ground fault protection.

6. Over-temperature protection for electronics.

7. Protection against internal faults.

8. Ability to start into rotating motor (forward or reverse rotation).

9. Additional protection and control as indicated and as required by the motor and driven equipment.

Z. Service Conditions: The VFD shall be designed and constructed to satisfactorily operate within the following service conditions.

1. Ambient temperature: 0 to 40 degrees C

2. Humidity: 0 to 95 percent, non-condensing

3. AC line voltage variation: plus 10 percent to minus 10 percent.

4. AC line frequency variation: 47-62 Hz.

AA. Operator Interface: The drive shall have an operator interface (HIM) module with LCD display and full numeric keypad. The operator interface shall be accessible from the front of the enclosure without opening any doors.

BB. Properly identified screw type terminal boards shall be provided for interconnection to remote controls.

2.3 VFD PACKAGED SYSTEM

A. Features

1. Ratings

1. Voltage

1) Capable of accepting nominal plant power of 480V AC at 60Hz.

2) The supply input voltage tolerance shall be ± 10% of nominal line voltage.

2. Displacement Power Factor

1) Six-pulse VFD shall be capable of maintaining a minimum true power factor (Displacement P.F. X Distortion P.F.) of 0.95 or better at rated load and nominal line voltage, over the entire speed range.

2) Eighteen-pulse VFD shall be capable of maintaining a minimum true power factor (Displacement P.F. X Distortion P.F.) of 0.98 or better at rated load and nominal line voltage, over the entire speed range.

3. Efficiency

1) A minimum of 96.5% (+/- 1%) at 100% speed and 100% motor load at nominal line voltage.

2) Control power supplies, control circuits, and cooling fans shall be included in all loss calculations.

4. Operating ambient temperature range without de-rating: 0 °C to 40 °C (32 °F to 104 °F)

5. Operating relative humidity range shall be 5% to 95% non-condensing.

6. Operating elevation shall be up to 1000 Meters (3,300 ft.) without de-rating.

2. Sizing

1. Systems rated at Normal Duty loads shall provide 110% overload capability for up to one minute and 150% for up to 3 seconds.

2. Systems rated at Heavy Duty loads shall provide 150% overload capability for up to one minute and 180% for up to 3 seconds.

3. Auto Reset/Run

1. 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.

4. Ride-Through

1. 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 greater than 20%, the drive shall stop the motor and issue a power loss alarm signal to a process controller, which may be forwarded to an external alarm signaling device.

5. Run on Power Up

1. The VFD system shall provide circuitry to allow for remote restart of equipment after a power outage. Unless indicated in the contact drawings, faults due to power outages shall be remotely resettable. The VFD system shall indicate a loss of

power to a process controller, which may be forwarded to an external alarm signaling device. Upon indication of power restoration the process controller will attempt to clear any faults and issue a run command, if desired.

6. Communications

1. VFD shall be capable of communicating on multiple networks.

2. VFD shall be capable of supporting the following network options:

1) EtherNet/IP

2) Other protocols as required

7. Enclosure Door Mounted Human Interface Module (HIM)

1. VFD shall provide a HIM with integral LCD display, operating keys and programming keys.

2. An enclosure door-mounted HIM, rated NEMA/UL Type 1 or NEMA/UL Type 4/12, shall be provided.

3. The HIM shall have the following features:

1) A seven (7) line by twenty-one (21) character backlit LCD display with graphics capability.

2) Shall indicate drive operating conditions, adjustments and fault indications.

3) Shall be configured to display in the following three distinct zones:

a. The top zone shall display the status of direction, drive condition, fault / alarm conditions and Auto / Manual mode.
b. The middle zone shall display drive output frequency.
c. The bottom zone shall be configurable as a display for either programming menus / information or as a two-line user display for two additional values utilizing scaled units.

4) Shall provide digital speed control.

5) The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.

B. Enclosure

1. Shall be rated NEMA/UL Type 1

2. Shall be painted per the manufacturer's standard.

3. Shall provide entry and exit locations for power cables.

4. Shall contain a label for UL508.

5. The drive system nameplate shall be marked with system Short Circuit Current Rating (SCCR).

C. Drive Enclosure Input Disconnect

1. Provide an enclosure door interlocked disconnect with thermal magnet circuit breaker

2. Operator Handles

1. Provide externally operated main disconnect handle.

2. Handles shall be lockable with up to three lockout / tagout padlock positions.

D. Fuse Protection

1. Input fuse protection shall be provided.

E. Control Power Transformer

1. Provide a control power transformer mounted and wired inside of the drive system enclosure.

2. The transformer shall be rated for the VFD power requirements.

F. Fan Cooling Control

1. Provide Transformer and Bridge Fans as required to maintain nominal temperature during 100% operation at max ambient.

2. Provide low temperature shut down switch for all fans when cooling is not needed.

2.4 POWER CONDITIONING

A. Where shown on the drawings the CONTRACTOR shall provide:

1. Line Reactor: Line reactors shall be designed for use as output filters for AC-PWM VFDs. The windings shall be copper with 600VAC Class H insulation, bobbin construction, laminated iron core, and rated for 200 percent capacity for 3 minutes. The reactors shall be enclosed in a NEMA 1 enclosure and include wire terminals, and be UL-listed. The reactors shall be **MTE Matrix AP**, or equal. Provide all required control wiring for integration with the drive. Provide structural support from the floor as required to accommodate the equipment weight and mounting.

2. Load Reactors

1. For lead lengths less than 100 feet TransCoil Inc. Model KDR

2. For Lead Lengths 100 feet and over TransCoil Inc. Model V1K

3. For Lead Lengths over 300 feet provide VFD manufacturer approved filter and factory review of the proposed installation.

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 Devicenet interface card.

3. One (1) spare keypad access device (HIM).

4. The OWNER currently has spare parts for Allen-Bradley drives. Unless the CONTRACTOR is providing Allen-Bradley drives, the CONTRACTOR shall provide 10% spares of the drives installed under this Contract and at least one (1) driver of each size.

2.6 MANUFACTURERS

A. The variable frequency drive units for 480V motors shall be **ABB ACQ580-1.** Drive is the basis of design.

B. Panel size shown on plans is based on ABB drives. CONTRACTOR shall make all necessary modifications to accommodate the selected drive.

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 26 29 23

SECTION 26 32 13 – NATURAL GAS / PROPANE-FIRED GENERATOR

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide a packaged propane fired engine generator (with natural gas backup) in a sound attenuated, weatherproof enclosure with all associated controls and required accessories as specified and shown on the plans and as described herein. The systems shall include, but not be limited to, engine-generator, starting battery, battery charger, annunciator/controller, SCADA interface, conduit, wire, fittings, residential zone silencer/enclosure attenuation required to provide a complete operating system. The work also includes the furnishing of all labor, materials, equipment, installation, testing, and training to provide a complete and workable power system, including the generator set and generator set controls as shown on the plans, drawings, and specifications herein. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans, drawings, and specified herein.

B. Booster Station will require a 480Y/277V, 3-phase, 4-wire supply.

C. The requirements of Section 26 05 00 –Electrical Work, General, Section 26 36 23 - Automatic Transfer Switches and Section 26 05 26 – Grounding apply to the WORK of this Section.

1.2 REFERENCES

A. The generator set shall conform to the requirements of the following codes and standards:

1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.

2. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.

3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

4. IEC8528 part 4. Control Systems for Generator Sets

5. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.

6. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

7. Mil Std 461D –1993. Military Standard, Electromagnetic Interference Characteristics.

8. Mil Std 462D - 1993. Military Standard, Measurement of Electromagnetic Interference Characteristics.

9. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

10. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit; component level type tests will not substitute for this requirement.

11. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

1.3 QUALTY ASSURANCE

A. General: All materials shall be inspected for compliance with Section 26 05 00 – Electrical Work, General and shall be tested per Section 26 01 26 – Electrical Tests and the requirements herein.

B. Factory Tests: As specified in this section.

1.4 TYPE OF SYSTEM

A. The system shall be classed as an optional standby power system with the primary fuel being natural gas with secondary backup as propane.

1.5 SUBMITTALS

A. Submit for approval manufacturer's catalog information with complete description of all equipment, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number, each required interconnection between the generator set and the automatic transfer switch.

B. Make and model of engine and generator.

C. Make and models of all auxiliary equipment (vibration isolation, radiator, enclosure, etc.)

D. Manufacturer-published kilowatt output curve and published fuel consumption curve.

E. Unit ventilation and combustion air requirements.

F. Manufacturer-published transient response data of the complete engine-generator set upon 50%, 75% and 100% block loads at 1.0 pf. Data shall include maximum voltage dips, maximum frequency dips, and recovery time periods.

G. Location and description of supplier's parts and service facilities within a 250 mile radius of the job site, including parts inventory and number of qualified generator set service personnel.

H. Actual electrical diagram, including schematic diagrams and interconnection wiring diagrams for all equipment to be supplied.

I. Prototype test certification and specification and catalog data sheets showing all standard and optional accessories to be supplied.

J. Manufacturer warranty statements.

K. Engine altitude duration curve.

L. Generator motor starting curves showing the voltage dips versus starting kVA.

M. Manufacturer-published service manuals for engine, generator and switchgear.

N. Delete all superfluous information from the submittal data such as model numbers and options for equipment in the manufacturer's data sheet but not used on this project.

1.6 OWNER'S MANUALS

A. Submit Owner's Operation and Maintenance Manuals and other information necessary for the operation and maintenance of the system.

1.7 WARRANTY AND SERVICE

A. A five-year / 1500-hours basic extended warranty for the generator set shall be included to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from date of start-up. Optional warranties shall be available upon request.

B. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall be regularly engaged in a maintenance contract program to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions, adjustment to the generator, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and proper functioning of all systems.

1.8 MANUFACTURER

A. The engine generator system shall be finished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system.

B. The equipment shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.

C. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production, installation, and service of their complete product line.

1.9 SUPPLIER

A. It is essential that the engine-generator supplier maintains a local parts and service facility within the State of Alaska. The supplier must carry sufficient inventory to cover no less than 80% parts

service within 24 hours and 95% within 48 hours. Further, the supplier shall have factory-trained service representatives to furnish all installation, test, and start-up supervision necessary for final approval and acceptance as well as perform maintenance and repairs on all components as required.

1.10 TESTING--MANUFACTURER

A. To assure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests for the generator set and automatic transfer switch: design prototype tests, final production tests, and shop tests.

B. Generator Set Design Prototype Tests: Components of the emergency system such as the engine/generator set and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes and pre-production models, which will not be sold, shall have been used for the following tests.

1. Maximum power (kW).

2. Maximum motor starting (kVA) at 35% instantaneous voltage dip.

3. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.

4. Governor speed regulation under steady state and transient conditions.

5. Voltage regulation and generator transient response.

6. Harmonic analysis, voltage waveform deviation, and telephone influence factor.

7. Three-phase short circuit tests.

8. Alternator cooling air flow.

9. Torsional analysis to verify that the generator set is free of harmful torsional stresses.

10. Endurance testing.

C. Generator Set Production Tests

1. Final Production Tests: Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:

a. Single-step load pickup.

b. Transient and steady—state governing.

c. Safety shutdown device testing.

d. Voltage regulation.

e. Rated Power @ 0.8 PF

f. Maximum Power.

2. Upon request, arrangements to either witness this test will be made, or a certified test record will be sent prior to shipment.

D. Site Tests

1. Site Tests: An installation check, start-up, and load test shall be performed by the manufacturer's local representative. The ENGINEER, regular operators, and the maintenance staff shall be notified a minimum of two weeks prior to the time and date of the site test. The tests shall include:

a. A load test applied for a 4-hour period at full load. A load bank of sufficient size shall be used to provide a load equal to 100 percent of the nameplate kW rating.

b. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.

c. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery charger, generator strip heaters, remote annunciator, etc.

d. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and frequency, and phase rotation.

e. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown using both natural gas utility supply and on-site propane backup supply. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test. An external load bank shall be connected to the system to load the generator to the nameplate kW rating. Step loads of ¼, ½, ¾ and full load shall be applied and the voltage dip, phase current and frequency recorded. The generator shall be run at full load for a minimum of two hours and any parameters (voltage, frequency, temperature, etc.) that measure outside of manufacturer’s specifications shall be investigated and corrected.

f. Test of automatic switch over from natural gas utility supply to on-site propane backup to simulate loss of utility supply.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. The generator set shall be sized as 150kW/188kVA and operate at 480Y/277 volts, 3-phase, 60Hz, 0.8 power factor.

B. Engine generator shall be housed in a sound attenuated, weatherproof enclosure mounted on a concrete pad.

C. The generator set shall be capable of a Standby 125°C rating while operating in an ambient condition of less than or equal to 77° F and a maximum elevation of 656 feet above sea level.

D. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying required KVA for starting motor loads with a maximum instantaneous voltage dip of 20%, as measured by a digital RMS transient recorder in accordance with IEEE standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip i.e. engine, alternator, voltage regulator and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

E. Vibration seismic rated isolators shall be provided between the engine-generator and heavy-duty steel base.

2.2 ENGINE

A. The engine shall deliver a minimum HP at a governed speed of 1800 rpm. The engine shall be equipped with the following:

1. An electronic isochronous governor capable of +0.5% steady-state frequency regulation.

2. 12 Volt positive engagement solenoid shift-starting motor.

3. 70-Ampere minimum automatic battery charging alternator with solid-state voltage regulation.

4. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.

5. Dry-type replaceable air cleaner elements for normal applications.

6. Engine-driven or electric fuel transfer pump capable of lifting fuel 7 feet, fuel filters, and electric solenoid fuel shut-off valve.

B. The engine shall be fueled by with propane. System shall be dual fuel capable with automatic switchover to natural gas in the future when the utility is available. Provide a pressure regulator from the 2 psi gas supply branch to reduce the pressure to that required by the engine. Provide a propane vaporizer and regulator set on the liquefied propane supply.

C. The engine shall have a minimum of 8 cylinders, and be liquid-cooled by a unit-mounted radiator, blower fan, water pump, and thermostats. This system shall properly cool the engine with up to 0.5 inches H20 static pressure on the fan in an ambient temperature up to 122F/50C.

2.3 ALTERNATOR

A. The alternator shall be salient-pole, brushless, 2/3-pitch, 12 lead, self-ventilated with drip-proof construction and amortisseur rotor windings and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to Standby 125°C. The excitation system shall be of brushless construction controlled by a solid- state voltage regulator with PMG 3-phase sensing capable of maintaining voltage within ±2.0% at any constant load from 0% to 100% of rating. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.

B. The alternator shall have a single maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.

C. The generator shall be inherently capable of sustaining at least 250% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current support devices.

2.4 CONTROLLER

A. Set-mounted controller capable of facing right, left, or rear, shall be vibration isolated on the generator enclosure. The controller shall be capable of being remote-mounted. The microprocessor control board shall be moisture proof and capable of operation from -40ºC to 85ºC. Relays will only be acceptable in high-current circuits.

B. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include the following features:

1. Fused DC circuit.

2. Complete 2-wire start/stop control, which shall operate on closure of a remote contact.

3. Speed sensing and a second independent starter motor disengagement systems shall protect against starter engagement with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.

4. The starting system shall be designed for re-starting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.

5. Cranking cycler with 15-second ON and OFF cranking periods.

6. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.

7. Circuitry to shut down the engine when signal for high coolant temperature, low oil pressure, low coolant level or overspeed is received.

8. Engine cool down timer factory set at 5 minutes to permit unloaded running of the standby set after transfer of the load to normal.

9. 3-position (Automatic-OFF-TEST) selector switch. In the TEST position, the engine shall start and run regardless of the position of the remote starting contacts. In the Automatic position, the engine shall start when contacts in the remote control circuit close and stop 5 minutes after those contacts open. In the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault shall also be accomplished by putting the switch to the OFF position.

10. Alarm horn with silencer switch per NFPA 110.

C. Standard indicating lights to signal the following shall be included:

1. Not-in-Auto (flashing red)

2. Overcrank (red)

3. Emergency Stop (red)

4. High Engine Temperature (red)

5. Overspeed (red)

6. Low Oil Pressure (red)

7. Battery Charger Malfunction (red)

8. Low Battery Voltage (red)

9. Low Fuel (red)

10. Auxiliary Pre-alarm (yellow)

11. Auxiliary Fault (red)

12. System Ready (green)

D. Test button for indicating lights.

E. Terminals shall be provided for each indicating light above, plus additional terminals for common fault and common pre-alarm.

2.5 INSTRUMENT PANEL

A. The instrument panel shall include the following:

1. Dual range voltmeter 3 1/2-inch, +/- 2% accuracy
2. Dual range ammeter 3 1/2-inch, +/- 2% accuracy.
3. Voltmeter-ammeter phase selector switch.
4. Lights to indicate high or low meter scale.
5. Direct reading pointer-type frequency meter 3 1/2-inch, 0.5% accuracy, 45 to 65 Hz scale.
6. Panel-illuminating lights.
7. Battery charging voltmeter.
8. Coolant temperature gauge.
9. Oil pressure gauge.
10. Running-time meter.
11. Voltage-adjust rheostat

2.6 ACCESSORIES

A. A UL 1077 listed, 80% rated line circuit breaker of (as indicted on the drawings) amperes, molded-case type, generator-mounted with load side lugs.

B. Engine block heater. Thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA-99 and NFPA-110, Level 1.

C. Generator Enclosure Heater. The generator heater shall prevent the accumulation of moisture and dampness in the generator windings. The heater shall be wired on at all times.

D. A re-settable line current sensing circuit breaker with inverse time versus current response shall be furnished which protects the generator from damage due to its own high current capability. This breaker shall not trip within the 10 seconds specified above to allow selective tripping of down-stream fuses or circuit breakers under a fault condition. This breaker shall not automatically reset, preventing restoration of voltage if maintenance is being performed. A field current-sensing breaker will not be acceptable.

E. Weatherproof/Sound Enclosure shall be as follows:

1. Enclosures shall be constructed from G60 galvanized high strength, low alloy steel. Wind rated to 150 mph.

2. The enclosure shall be primed with BASF urethane and finish coated with BASF Superl System paint. Enclosures will be finished in the manufacturer's standard color.

3. The enclosures must allow the generator set to operate at full load in an ambient of 40°C with no additional derating of the electrical output.

4. The enclosures must meet all of the requirements of UL-2200.

5. Enclosures must be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear-facing door is required. Access to the controller and main line circuit breaker must meet the requirements of the National Electric Code.

6. Doors must be hinged with stainless steel hinges and hardware and be removable.

7. Doors must be equipped with lockable latches. Locks must be keyed alike.

8. Enclosures must be mounted to the generator set skid.

9. The enclosure roof must be pitched to prevent accumulation of water

10. A duct between the radiator and air outlet must be provided to prevent re-circulation of hot air.

11. The complete exhaust system shall be internal to the enclosure. Enclosures with roof mounted or externally exposed silencers are not acceptable.

12. The silencer shall be an insulated critical silencer with a tailpipe and rain cap.

13. All acoustical foam must be fixed to the mounting surface with pressure sensitive adhesive. In addition, all acoustical foam mounted a horizontal plane must be mechanically fastened. The acoustical foam must have a protective film facing to act as a barrier for liquids.

14. The enclosures must include an exhaust scoop to direct the cooling air in a vertical direction.

15. The sound pressure level shall not exceed 70dBA at 7 meters, at full load, measured 1.5 meters above grade.

F. 12-volt lead-antimony batteries capable of delivering the manufacturer's recommended minimum cold-cranking Amps required at 0ºF, per SAE Standard J-537, shall be supplied.

G. 10-Ampere, UL 1236 listed, automatic float and equalize battery charger. The charger shall be designed for heavy-duty industrial service and be capable of full-rated output indefinitely at temperatures between -10°C and +50°C. The charger shall be capable of recharging a fully discharged battery of the maintenance-free lead acid, conventional (wet) lead acid or nickel-cadmium type. The charger shall maintain the battery automatically and minimize the need for battery electrolyte replenishment. Conservatively rated SCRs and diodes in full-wave bridge shall be used. A crank disconnect relay shall not be required to protect the charger from overload. The

charger shall be wall mounted and natural convection cooled. The housing shall be constructed of rustproof metal (e.g., aluminum) and treated with a protective coating.

1. Battery Charger Input: The charger shall operate from: 120 V ±10%, 60 Hz ±3% AC mains. The charger shall incorporate a soft-start feature in which the output is gradually increased from zero to full, required output within 5 to 10 seconds. Input protection shall consist of fuses or circuit breakers. Proven surge suppression devices shall be fitted.

2. Battery Charger Output: Output voltage shall be 12 volts nominal. Float voltage shall be adjustable from 100% to 120% of nominal. Equalize voltage shall be adjustable up to 15% above float voltage. Output voltage adjustments shall be on separate potentiometers in the charger. The charger shall incorporate automatic current limiting with a rectangular current limit characteristic, and shall be capable of operating into a short circuit or dead battery indefinitely without damage or overheating. The charger shall be equipped with output fuses or circuit breakers.

3. Regulation and Temperature Compensation:

    a. Voltage regulation shall be within ±1 of the correct temperature-compensated value from no load to full load with simultaneous variations of ±10% input voltage and ±5% input frequency. The DC output shall be constant voltage and current limited. The charger's current limit shall be fixed between 100% and 110%. Input transient protection shall be provided. The charger shall be protected against damage by reverse connection of the battery.

    b. The charger shall be equipped with an automatic high rate (equalize) charge facility operating in response to the battery's state of charge. The charger shall operate at the high rate until the battery is fully charged, then revert to float voltage to prevent overcharging. High rate operation shall be governed by the requirement of the battery. Mechanical or electronic timers shall not be used.

    c. The charger shall incorporate automatic ambient temperature compensation to maximize battery performance and life. Temperature coefficient shall be (-0.18%) per degree C to assure correct charging in all temperatures.

    d. The charger shall automatically compensate for voltage drop in the charging leads to prevent charging errors due to long cable runs.

4. Float/Equalize Control: The charger shall include an automatic equalize feature that is activated when the battery's state of charge is reduced. Individual adjustment potentiometers shall be provided for float voltage, boost voltage and alarm voltages.

5. Indicators and Optional Alarms:

    a. Meters for output amperes and voltage shall be provided.

    b. The battery charger shall incorporate an alarm system providing indication of charger and battery status by LED displays and form C contacts. Separate contacts for low-battery voltage and charger fail shall be provided. An LED shall indicate input power on.

6. Standard Nameplate Data: A standard permanent adhesive nameplate is to contain the following data:

   a. Supplier name, city and state

   b. Product description

   c. Model number

   d. Serial number/date code

   e. Input voltage rating

   f. Input frequency rating

   g. Input current rating

   h. Nominal output voltage rating

   i. Output current rating

7. Drawings And Documents:

   a. A final test report is to be supplied with each charger. In addition, one user manual per charger is to be supplied that contains the information described below. Drawings and documents are to reflect the manufacturer's standard, cataloged product.

   b. Documents and drawings are to be created to good commercial practice, and are to be supplied on standard 11" x 17" paper, or on 8.5" x 11" paper.

   c. The user is to provide:

      1) Safety instructions

      2) Product description

      3) Mechanical installation instructions, with drawings

      4) AC input ratings and terminal configurations

      5) Electrical connections

      6) Operation instructions with explanation of operating modes and controls

      7) Output adjustments, along with standard factory settings and description and chart of temperature compensation operation

      8) Troubleshooting table

      9) Component diagnostic tests

      10) Detailed theories of operation for all circuits

   d. The following drawings are to be appended to user manual:

1) Detailed dimensional drawing

2) Connections drawing, with maximum wire sizes shown

3) Power circuit schematic

4) Control board schematic, with component values

5) Alarm board schematic, with component values

8. Quality Assurance, Inspection And Test

a. Quality Assurance: The following quality assurance steps are to be included in the manufacturer's standard procedure:

1) Source control documents are maintained on all purchased parts

2) A master list of all approved purchased components and vendors is maintained

3) All assembly personnel are trained in the manufacture of the product

4) Bills of material, drawings, procedures, photographs, visual method sheets and other documents affecting the manufacture and test of the product are controlled so that engineering changes are immediately incorporated.

5) Inspection is performed at every step of the assembly process. (Quality is "built-in" rather than "inspected in.")

b. Standard Factory Assembly and Test Procedure: The standard assembly process is to prescribe the tests and calibration that are to be performed on the product. These activities are to include, but are not limited to, the following:

1) Insulation breakdown test using a "hipot" device to the standards prescribed in UL 1012.

2) Performance testing to insure that critical performance specifications are met. These are to include operation at low and high AC line voltage, output ripple and regulation.

3) Calibration to the correct output, alarm and shutdown voltages

9. Warranty: The manufacturer is to warrant its products to be free of defects in material or workmanship for a period of two years from date of shipment.

10. Manufacturers, Or Equal: Compact: **SENS model FCA12-10-2411U**, or equal.

H. The engine exhaust silencer shall be coated to be temperature and rust resistance, rated for critical application. The silencer will reduce total engine exhaust noise as required to meet dB(A) requirements.

I. Gas-proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.

J. Two flexible fuel lines rated 257°F and 100 psi ending in pipe thread.

K. Air cleaner restriction indicator to indicate the need for maintenance of the air cleaners.

L. Engine crankcase emission canister.

M. The 10 relay dry contact kit provides normally open and normally closed contacts in a form C configuration to activate warning devices and other customer provided accessories allowing remote monitoring of the generator set. Typically, lamps, audible alarms, or other devices signal faults or status conditions. At a minimum, a generator 'Not-in-Auto' signal shall be provided.

N. Run Relay to provide a three-pole, double-throw relay with 10 amps at 250 VAC contacts for indicating that the generator is running.

O. A radiator duct flange to provide a convenient connection to duct work for the radiator discharge air.

P. Common Failure relay to remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.). Once energized the relay shall remain latched until the system is reset by the main controller switch.

Q. Generator controller 'Monitor' software and all required cables and connectors as required allowing Owner to connect a laptop to the generator's control panel and make any necessary controller adjustments.

PART 3 - EXECUTION

3.1 MANUFACTURER

A. Engine-generator shall be **Cummins** or approved equal. Cummins provided the basis of design for this project.

B. Engine-generator shall be factory assembled, dynamically balanced and full load tested with specified coolant protection as a complete system prior to shipment as a complete assembly from the factory. Submit copy of factory test report.

3.2 INSTALLATION

A. Install engine-generator in the sound attenuated, weatherproof enclosure on a concrete pad as shown on the plans.

B. Mount engine-generator on vibration isolators per manufacturer's requirements.

C. Provide the necessary electrical connections for proper operation of the engine intake and exhaust dampers.

D. Mount batteries adjacent to engine. Make all connections to starter and battery charger.

E. All wiring shall comply with NEC Article 700.

F. Make all fuel line connections between the engine-generator and both the natural gas and liquefied propane service.

G. Make all ducting connections between the engine-generator and enclosure dampers.

3.3 STARTUP AND INSTRUCTION

A. After delivery of the unit to the site, secure the unit to the site foundation and make all necessary fuel line and electrical connections to the unit. Once all connections have been made, coordinate with the ENGINEER to provide start-up of the system. Provide all engine fluids (oil, coolant, etc.) necessary prior to start-up and testing. Run the engine-generator under full available site load for a minimum of 2 hours. In addition, simulate two power failures with load transfer with normal cool-down cycle. Demonstrate all automatic features as directed by the OWNER's representative. Record voltage amperage and frequency during each test. Note any required adjustments. Furnish record of tests to the OWNER.

B. Furnish maintenance records for OWNER's use.

C. Parts books covering the engine, generator, and major auxiliary equipment shall be provided to the OWNER.

D. Procedures on operating and maintenance of the standby power system shall be explained to operating personnel at this time. Provide a minimum of 4 hours of training.

3.4 SCHEDULED OIL SAMPLING

A. In order to forecast and minimize engine downtime, the supplier of the equipment must provide an oil sampling analysis kit which operating personnel shall utilize for Scheduled Oil Sampling.

B. The laboratory to which oil samples will be sent shall be located at and a part of the local generator set supplier's facility and shall be open to inspection during normal working hours. Independent laboratories not a part of the engine supplier's facility are disallowed as to conformance with this specification.

C. Scheduled Oil Sampling shall be of the atomic absorption spectrophotometry method and shall be accurate to within a fraction of one part per million for the following elements: Iron, Chromium, Copper, Aluminum, Silicon, Lead.

D. In addition, the sample shall be tested for the presence of water, and antifreeze.

E. All equipment needed to take oil samples shall be provided in a kit at the time of acceptance and shall include the following:

1. Sample extraction gun (1).

2. Bottles (10).

3. Postage-paid mailers (10).

4. Written instructions (1).

F. Immediate notification shall be provided to the owner when analysis shows any critical reading. If readings are normal, a report showing that the equipment is operating within established parameters shall be provided.

G. This Scheduled Oil Sampling kit shall be made available, at additional cost, to the owner beyond the mandatory starter kit specified previously and shall be optional for the owner to continue this service after the starter kit has been depleted.

3.5 SYSTEM SERVICE CONTRACT

A. In order to meet potential insurance company regulations and provide longest reliable service life, the supplier of the standby power system shall provide and make available to the owner a service contract which, at the owner's option, may be accepted or refused. The contract shall be for the complete services rendered over a period of five years and shall include, but not be limited to, the following:

1. Engine manufacturer's recommended procedures for weekly (biweekly) inspection and maintenance to be done by user.

2. Quarterly inspection by the supplier personnel to review the weekly (biweekly) maintenance records being kept by user and train any new owner operating personnel. Inspection will include scheduled oil sampling for lube oil contaminants as outlined in above paragraph 3.04. A system load test run on the generator set shall also be included.

3. Annual inspection shall include all of items in above paragraph.

END OF SECTION 26 32 13

SECTION 26 33 05 – DC POWER SUPPLY/BATTERY CHARGER CABINET

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide the single-phase heavy-duty industrial battery charger and all accessories required, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 26 05 00 – Electrical Work, General, apply to the WORK of this Section.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The charger is to be designed and built in accordance with UL 1012, the general requirements of NEMA PE-5 and best commercial practice for industrial and utility grade rectifier/chargers. Models marked "UL listed" are to be listed to UL 1012.

1.3 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings and catalog data in accordance with Section 26 05 00. Submit information sufficient to indicate the scope and quality of the battery charger installation.

1. Equipment arrangement, outlet devices, and special mounting details.

2. Wiring diagrams showing terminal identification for field-installed wiring.

3. Catalog literature.

1.4 QUALITY ASSURANCE

A. Industrial battery charger system components shall be manufactured by firms that are regularly engaged in the production of such systems, including auxiliary equipment similar to that required by this Contract, and that have been in satisfactory service for at least 10 years.

PART 2 - PRODUCTS

2.1 SCADA PANEL DC POWER SUPPLY/BATTERY CHARGER

A. Charger Description

1. Charger is to be a fully regulated, constant voltage, current limited unit designed for heavy-duty industrial service and be capable of full rated output over its entire specified operating envelope. Charger is to be capable of recharging a fully discharged VRLA, flooded lead-acid or nickel cadmium battery while powering a parallel connected load.

2. Charger topology is to be single phase, full wave, SCR type with a current limiting and single or two-stage output LC filter to provide low ripple DC.

B. Charger Operation and Application: The charger is to provide fully automated recharge and maintenance of the system battery. The charger shall automatically determine the need for boost (high rate) charging based on the battery's state of charge. A standard temperature compensation system is to automatically adjust charge voltage based on ambient temperature.

C. Safety Isolation: Electrical isolation from input AC mains to output DC is to be maintained through the use of power transformers that meet the isolation requirements of UL 1012. Transformers are to be de-rated to operate within UL specified temperature limits.

D. AC Mains Supply

1. The charger is to be designed to operate from 120-volt ± 10%, 60 Hz ± 5%, AC mains.

E. Output

1. Output Voltage Rating and Adjustment: 24 volts DC nominal. The float voltage is to be adjustable from 100% of nominal to 120% of nominal (24 volts to 28.8 volts). Boost voltage is to be adjustable up to 15% above float voltage.

2. Battery Compatibility: The standard output voltage is to be compatible with (i.e., the charger will meet all its published specifications) the following battery configurations:

		Lead-acid	
	VRLA	Flooded	Ni-Cd
Cells	11-12	11-12	17-19

3. Float/Boost/Automatic Mode Control: Two modes of voltage operation are to be provided, float mode and boost mode (also known as "equalize".) A three-position selector switch is to allow manual selection of float mode or boost mode. The third position is to place the charger in automatic boost mode. Automatic boost mode is to cause the charger to operate in boost mode only when the current demanded exceeds about 70% of the charger's maximum rated current. When the current demand drops to about 50% of the charger's rating the charger is to resume float mode operation where it is to remain until the next high demand from the battery.

4. Output Current Limit: The current limit is to be of the rectangular type (full current is to be available regardless of load) to prevent overstress of charger components. Current limit is to provide protection from overload and output short circuit. Current limit is to be factory set at between 100% and 105% of rated output current. Current limit is to be adjustable up to 110% of rated output.

5. Output Regulation: The static output voltage regulation in float mode is to be +1% of the correct temperature compensated voltage from no load to full load for rated AC input.

a. Output Voltage Temperature Compensation: The charger's output voltage is to be temperature compensated to minus 0.18% per degree Celsius. The temperature

compensation curve is to be linear until +10 degrees C, below which the output voltage is to stop increasing. Battery temperature sensing is to be accomplished by a sensor located on the control card.

6. Output Stability: The charger is to operate in a stable condition when driving a DC load either with parallel connected battery or without battery.

7. Output Ripple: To be less than 30-mV rms when connected to a battery rated in ampere-hours four times the charger's output ampere rating, the ripple without battery is to be less than 100-mV rms.

8. Voltage Sensing Point: Voltage sense is to be at the output terminals of the charger.

F. Protection

1. Surge Suppression – AC Input: MOV surge suppression is to be fitted to the secondary side of the input isolation transformer.

2. Surge Suppression – DC Output: The output filter is to have high value inductance and capacitance to provide robust protection against high-energy transients.

3. Input Overcurrent Protection Device is to be provided by a thermal magnetic two-pole circuit breaker with UL-listed amp interrupting rating of 10,000 amps at 240 volts AC, 60 Hz.

4. Output Overcurrent Protective Device is to be provided by a thermal magnetic two pole circuit breaker with UL-listed interrupting rating of 5,000 amps at 48 volts DC.

5. High Voltage Shutdown (HVS): HVS is to activates if the output voltage exceeds a preset value. After shutdown, the charger is to restart after the battery voltage drops below nominal. HVS is to deactivate the SCR drive.

G. Status Indicators and Alarms

1. AC On Indicator: A green LED is to indicate that an AC main is present, and that the input breaker is turned on.

2. AC Fail Indicator and Alarm: A red LED and a Form C contact, double-pole, double-throw (DPDT) is to indicate that the AC power has failed, or that the AC input breaker is open.

3. Low Battery Voltage Indicator and Alarm: A red LED and a Form C contact (DPDT) is to indicate that the battery voltage has dropped below an adjustable threshold. There is to be a delay of approximately 20 seconds after onset of the alarm condition and activation of the relay contact.

4. High Battery Voltage Indicator and Alarm: A red LED and a Form C (DPDT) contact is to indicate that the battery voltage has risen above an adjustable threshold.

5. Charge Fail Indicator and Alarm: A red LED and a Form C contact (DPDT) is to indicate that the charger is not producing the current demanded by the battery and/or

load. This alarm is to activate when the AC has failed or when a charger malfunction has occurred. This alarm is to be based on measured output current. If there is current demanded but no output produced, the alarm is to be activated. The alarm must not activate if no current is demanded, thus preventing false alarms.

6. High Volt Shutdown Indicator and Alarm: A red LED and a Form C contact (DPDT) is to indicate when the charger has shut down due to excessive output voltage.

7. Summary Alarm: A Form C (DPDT) contact is to operate if any alarm condition except high voltage shutdown has occurred.

8. Remote Contact Ratings: One set of Form C remote contacts is to be provided for each alarm. Contacts are to be non-latching, and automatically reset after the fault condition ends. Contact rating is to be 2A @ 26 VDC or 0.5A @117 VAC.

9. DC Voltmeter: A precision DC meter of 3.5” width, with 2% accuracy is to be provided to indicate charger output voltage.

10. DC Ammeter: A precision DC meter of 3.5” width, with 2% accuracy is to be provided to indicate charger output current.

H. Controls and Adjustments

a. Controls

b. 2-pole AC input breaker

c. 2-pole DC output breaker

d. Output charge mode

e. Alarm LED test

2. All controls are to be accessible with the front door closed

I. Environmental Requirement

1. Ambient

a. Temperature: -20C to +50C

b. Humidity: 5% to 95%, non-condensing

c. Altitude: 0-10,000 ft; no derating

2. Cooling: Convection cooled.

J. Mechanical

1. Installation: The unit is to be designed for installation on a wall or bulkhead, or in a 19" relay rack. A maximum of 12 inches of free space above and 6 inches below the unit is required for proper flow of cooling air.

2. Cabinet Type: NEMA-1.

3. Power Connections: Input and output connections are to be made direct to the input and output DC circuit breaker compression terminals.

4. Alarm Connections: All alarm connections are to be made to compression terminals inside the charger. The wire size for all connections is to be #14 AWG.

5. Housing material is to be 0.125" 5052 H32 aluminum, heavy clear anodized.

6. Metal Finish: Corrosion protection is to be inherent in the metal plating.

2.2 DESCRIPTION OF BATTERY CHARGER

A. Charger Description

1. The charger shall be designed for heavy-duty industrial service and be capable of full-rated output indefinitely at temperatures between -10°C and +50°C. The charger shall be capable of recharging a fully discharged battery of the maintenance-free lead acid, conventional (wet) lead acid or nickel-cadmium type. The charger shall maintain the battery automatically and minimize the need for battery electrolyte replenishment. Conservatively rated SCRs and diodes in full-wave bridge shall be used. A crank disconnect relay shall not be required to protect the charger from overload. The charger shall be wall mounted and natural convection cooled. The housing shall be constructed of rustproof metal (e.g., aluminum) and treated with a protective coating.

B. Battery Charger Input

1. The charger shall operate from: 120 V ±10%, 60 Hz ±3% AC mains.

2. The charger shall incorporate a soft-start feature in which the output is gradually increased from zero to full, required output within 5 to 10 seconds. Input protection shall consist of fuses or circuit breakers. Proven surge suppression devices shall be fitted.

C. Battery Charger Output

1. General Characteristics

a. Output voltage shall be 24 volts nominal. Float voltage shall be adjustable from 100% to 120% of nominal. Equalize voltage shall be adjustable up to 15% above float voltage. Output voltage adjustments shall be on separate potentiometers in the charger. The charger shall incorporate automatic current limiting with a rectangular current limit characteristic, and shall be capable of operating into a short circuit or dead battery indefinitely without damage or overheating. The charger shall be equipped with output fuses or circuit breakers.

2. Regulation and Temperature Compensation

   a. Voltage regulation shall be within ±1 of the correct temperature-compensated value from no load to full load with simultaneous variations of ±10% input voltage and ±5% input frequency. The DC output shall be constant voltage and current limited. The charger's current limit shall be fixed between 100% and 110%. Input transient protection shall be provided. The charger shall be protected against damage by reverse connection of the battery.

   b. The charger shall be equipped with an automatic high rate (equalize) charge facility operating in response to the battery's state of charge. The charger shall operate at the high rate until the battery is fully charged, then revert to float voltage to prevent overcharging. High rate operation shall be governed by the requirement of the battery. Mechanical or electronic timers shall not be used.

   c. The charger shall incorporate automatic ambient temperature compensation to maximize battery performance and life. Temperature coefficient shall be (0.18%) per degree C to assure correct charging in all temperatures.

   d. The charger shall automatically compensate for voltage drop in the charging leads to prevent charging errors due to long cable runs.

3. Float/Equalize Control

   a. The charger shall include an automatic equalize feature that is activated when the battery's state of charge is reduced. Individual adjustment potentiometers shall be provided for float voltage, boost voltage and alarm voltages.

4. Indicators and Optional Alarms

   a. Meters for output amperes and voltage shall be provided.

   b. The battery charger shall incorporate an alarm system providing indication of charger and battery status by LED displays and form C contacts. Separate contacts for low-battery voltage and charger fail shall be provided. An LED shall indicate input power on.

2.3 Uninterruptable Power Supply (UPS) Panel, 24 VDC:

The PACS panel shall be supplied from a battery-backed 24 VDC power supply panel. Each power supply module shall include a DC-OK relay contact that shall be wired to a discrete input card. For each enclosure, DC power supplies shall be a **Mean Well USA model #SDR 480-24 12V with redundancy module Model #DR-RDN20 and UPS module #DR-UPS40**. Enclosure cabinet shall be NEMA 12.

2.4 STANDARD NAMEPLATE DATA

A. A standard permanent adhesive nameplate is to contain the following data:

1. Supplier name, city and state
2. Product description
3. Model number
4. Serial number/date code
5. Input voltage rating
6. Input frequency rating
7. Input current rating
8. Nominal output voltage rating
9. Output current rating

2.5 DRAWINGS AND DOCUMENTS

A. A final test report is to be supplied with each charger. In addition, one user manual per charger is to be supplied that contains the information described below. Drawings and documents are to reflect the manufacturer's standard, cataloged product.

B. Documents and drawings are to be created to good commercial practice, and are to be supplied on standard 11" x 17" paper, or on 8.5" x 11" paper.

C. The user is to provide:

1. Safety instructions
2. Product description
3. Mechanical installation instructions, with drawings
4. AC input ratings and terminal configurations
5. Electrical connections
6. Operation instructions with explanation of operating modes and controls
7. Output adjustments, along with standard factory settings and description and chart of temperature compensation operation
8. Troubleshooting table
9. Component diagnostic tests
10. Detailed theories of operation for all circuits

D. The following drawings are to be appended to user manual:

1. Detailed dimensional drawing

2. Connections drawing, with maximum wire sizes shown

3. Power circuit schematic

4. Control board schematic, with component values

5. Alarm board schematic, with component values

2.6 QUALITY ASSURANCE, INSPECTION AND TEST

A. Quality Assurance: The following quality assurance steps are to be included in the manufacturer's standard procedure:

1. Source control documents are maintained on all purchased parts

2. A master list of all approved purchased components and vendors is maintained

3. All assembly personnel are trained in the manufacture of the product

4. Bills of material, drawings, procedures, photographs, visual method sheets and other documents affecting the manufacture and test of the product are controlled so that engineering changes are immediately incorporated.

5. Inspection is performed at every step of the assembly process. (Quality is "built-in" rather than "inspected in.")

B. Standard Factory Assembly and Test Procedure: The standard assembly process is to prescribe the tests and calibration that are to be performed on the product. These activities are to include, but are not limited to, the following:

1. Insulation breakdown test using a "hipot" device to the standards prescribed in UL 1012.

2. Performance testing to insure that critical performance specifications are met. These are to include operation at low and high AC line voltage, output ripple and regulation.

3. Calibration to the correct output, alarm and shutdown voltages

2.7 WARRANTY

A. The manufacturer is to warrant its products to be free of defects in material or workmanship for a period of two years from date of shipment.

2.8 MANUFACTURERS, OR EQUAL

A. Full-size: SCADA panel DC power supply/battery chargers shall be by **TecPro** as part of the OFCI equipment.

B. Provide DC Battery Supply/Charger for the SCADA Control Panel.

2.9 BATTERY PROVISION

A. Each SCADA panel DC power supply/battery charger is to be connected to a 24 V sealed lead acid battery rated at 103Ah at the 10-hour rate. Batteries are to be (2) units of the **Powersonic Battery model PS-121100**, or equal.

B. The batteries are to be provided with a proprietary wall mounting bracket that is rated for the seismic zone requirements at the site of installation.

PART 3 - EXECUTION

3.1 GENERAL

A. The industrial battery charger system shall be installed as indicated and shall conform to Section 26 05 00 – Electrical Work, General, and the equipment manufacturer's installation instructions.

B. The CONTRACTOR shall receive, store, and assemble all sections of the battery charger system to form complete units. The CONTRACTOR shall make all internal wiring interconnections as required for complete assembly of the system. Where wiring connectors are not supplied by the manufacturer, the CONTRACTOR shall furnish the connectors required to complete internal wiring terminations.

C. The CONTRACTOR shall take all necessary precautions to eliminate moisture and foreign material from the equipment at all times during storage and installation. Special care shall be taken to prevent corrosion of and damage to the battery charger system.

END OF SECTION 26 33 05

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 36 05 – HEAVY-DUTY SAFETY SWITCHES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. Furnish and install heavy-duty, double-throw safety switches for manual transfer of loads between alternate sources of supply and single-throw safety switches for motor disconnect.

B. Switch enclosures shall comply with the AREA DESIGNATIONS specified in Section 26 05 00 – Electrical Work, General.

1.2 CODES AND STANDARDS

A. The heavy-duty safety switches shall conform to the requirements of:

1. UL 98 – Enclosed Switches

1.3 SUBMITTALS

A. Provide outline drawings with dimensions, and equipment ratings for voltage, amperage and short circuit in accordance with Division 01 Specifications.

PART 2 - PRODUCTS

2.1 SAFETY SWITCH

A. The safety switches used as transfer switches shall be heavy-duty, manually operated, single-throw or double-throw switches, full load make or break rated. Switches shall include a NO contact that is made in the A and B position.

B. Switch shall be UL listed for use as service equipment and is to be labeled for this application.

C. Switch shall have switch blades which are visible when the switch is OFF and the cover is open.

D. Lugs shall be front removable and UL listed for aluminum or copper.

E. All current carrying parts shall be plated to resist corrosion.

F. The UL listed short circuit current rating of the double throw switch shall be 10,000 rms symmetrical amperes, unless otherwise noted.

G. Provisions for padlocking the switch in the OFF position shall be provided.

H. Motor disconnect switches installed in lift station pad mounted control panels shall be rotary disconnect switches **Allen-Bradley Bulletin 194RF**, or equal.

2.2 ENCLOSURE

A. The safety switch shall be furnished in a NEMA Type 1 enclosure, or as required by AREA DESIGNATION requirements of the Contract, with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvannealed steel.

B. The enclosure shall be supplied with a metal nameplate which includes ON-OFF-ON markings.

2.3 MANUFACTURERS

A. Safety switches shall be manufactured by **Square D, Allen-Bradley**, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The safety switch shall be installed in accordance with the Manufacturer's requirements and recommendations.

END OF SECTION 26 36 05

SECTION 26 36 23 – AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. Furnish and install automatic transfer switches (ATS) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each automatic transfer switch shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

1.2 CODES AND 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 (formerly ICS2-447) - AC Automatic Transfer Switches
8. UL 508 Industrial Control Equipment

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance City of Palmer Standard Construction Specification Requirements and Section 26 05 00 – Electrical Work, General.

PART 2 - PRODUCTS

2.1 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include

overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

B. The switch shall be positively locked and unaffected by momentary outages. All main contacts shall be silver composition. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors.

C. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.

2.2 MICROPROCESSOR CONTROLLER

A. The controller's sensing and logic shall be provided by a single built-in microprocessor.

B. A single controller shall provide twelve selectable nominal voltages. Voltage sensing shall be true RMS type and shall be accurate to ± 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 F and storage from -55 to +85 degrees F.

C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit.

D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

E. The controller shall be capable of pre-programmed auto-exercising of the standby system: transfer switch and generator. The pre-programmed auto-exercising sequence shall meet the requirements of NFPA 110.

F. 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.

2.3 ENCLOSURE

A. The ATS shall be furnished with a NEMA 1 rated, lockable, dead front enclosure unless otherwise shown on the Contract Drawings.

B. There are no penetrations allowed in door.

2.4 CONTROLLER DISPLAY AND KEYPAD

A. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters.

2.5 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal):

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.

2.6 TIME DELAYS

A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.

B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

C. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. All time delays shall be adjustable in 1 second increments using the LCD display and keypad.

2.7 ADDITIONAL FEATURES

A. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

B. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

C. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

D. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

E. An inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer.

F. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.

G. Self Diagnostics: The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

H. Communications Interface: The controller shall be capable of interfacing through an optional serial communication module.

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.

2.8 WITHSTAND AND CLOSING RATINGS

A. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.

B. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings.

2.9 ACCEPTABLE MANUFACTURERS

A. Automatic transfer switches shall be **Cummins** or **ASCO 7000 Series**, or equal.

PART 3 - EXECUTION

3.1 TESTS AND CERTIFICATION

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.

B. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation, and servicing in accordance with ISO 9001.

END OF SECTION 26 36 23

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 50 00 – LIGHTING

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide lighting fixtures, supports, 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 Division 01.

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/Drivers

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/drivers 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, or as required by the CKSS. 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. Interior fixtures within the chemical room shall be suitable for installation in this area.

C. Emergency Exit Signs

1. Internally illuminated.

2. Universal mounting type.

3. Internal 6-volt nickel cadmium battery, 90 minutes capacity to emergency lamps.

4. Two-rate regulated battery charger to minimize energy consumption. Filtered charger output to minimize voltage ripple and extend battery life. Thermal protection and current-limiting charger circuitry to prevent overheating and charger failure.

5. 19,000 hours expected lamp life.

6. Press to test button.

7. Directional arrows.

8. Red letters on a white panel, 6 inches high.

2.4 PHOTO-ELECTRIC CELLS

A. Photoelectric cells for control of multiple fixtures shall be self-contained, weatherproof type, rated for 1800 va 120-volt, single pole, single throw, and shall be provided with time-delay features. Photoelectric cell shall be **Tork Model 2101**, or equal.

2.5 LIGHT FIXTURE CONTROL RELAYS

A. Relays for light fixtures control shall be mechanically held. Such relays shall be based-mounted, single-purpose units, i.e., not attachments to a multi-purpose solenoid operator.

B. If not indicated otherwise, coil voltage shall be 115 VAC with contacts rated at 20 amps. Relays shall be **ASCO Series 166, Zenith Series MSC**, or equal.

2.6 FIXTURE TYPES

A. Specific requirements are located in the Lighting Fixture Schedule on the Contract Drawings.

PART 3 - EXECUTION

3.1 LUMINAIRES

A. Install in accordance with manufacturer's recommendations.

B. Provide necessary hangers, pendants, and canopies.

C. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building required to safely mount.

D. Install plumb and level.

E. Locate luminaires to avoid both conflict with other building systems and blockage of luminaire light output.

3.2 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 light sources at time of Substantial Completion.

END OF SECTION 26 50 00

DIVISION 33

UTILITIES

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 33 34 00 - ONSITE WASTEWATER DISPOSAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Construction of a small commercial facility complete sanitary sewer septic system, including sewer piping, septic tank, and soil disposal system.

1.2 INSTALLER REQUIREMENTS

A. Sanitary sewer septic system shall be installed by a Certified Installer registered with Alaska Department of Environmental Conservation (ADEC). Septic System shall comply with ADEC requirements.

1.3 REFERENCE STANDARDS

A. Alaska Department of Environmental Conservation (ADEC) Regulations 18 AAC 72

B. Uniform Plumbing Code, latest edition

1.4 MATERIALS

A. Use materials that conform to ADEC requirements and the following:

B. Sand Liner

1. Use material meeting the following for sand liner material where shown on the drawings:

TABLE I

U.S. Std. Sieve	Cumulative % Passing by Weight
#10	85-100
#20	60-90
#40	25-50
#60	0-15
#200	<5

2. The sand may not have more than 45% (of the total) passing any one sieve and retained on the next consecutive sieve of those shown in Table I above.

C. Sewer Rock

1. Use washed, screened, sound rock, 0.75” to 1.5” diameter, with less than 3% passing the #200 sieve.

D. Filter Fabric

1. Use non-woven fabric Typar 3401, Mirafi 140 N or approved equal.

E. Pipe and Fittings

1. Leach field pipe, fittings and monitoring tubes shall be 4" diameter HDPE SDR18. Laterals shall be perforated.

2. Building waste pipe, cleanouts and fittings shall be 4" diameter HDPE SDR18.

F. Septic tank

1. Steel or polyethylene, pre-manufactured, nominal 1,000 gallon, two-compartment tank septic tank, as manufactured by Anchorage Tank, Greer Tank, or approved equal.

PART 2 - PRODUCTS

2.1 SUBMITTALS

A. Submit Product Data for each of the following: Sand liner material, sewer rock, pipe and fittings, septic tank, geotextile fabric, sand if necessary.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Furnish and install all incidental parts not shown on the Drawings or specified in this Section that are necessary for a complete system.

B. Installation shall be in accordance with the Alaska Department of Environmental Conservation, Division of Environmental Health "Installer's Manual for Conventional Onsite Domestic Wastewater Treatment and Disposal Systems," latest edition.

C. Grade of finished surfaces to provide positive drainage away from the septic improvements

3.2 EARTHWORK

A. Protect subgrades from softening, undermining, washout and damage by rain or water accumulation. If necessary, install and maintain a dewatering system to keep subgrades dry.

B. Excavation

1. Excavate material only within the limits on the plans or as directed. Prevent disturbing material and vegetation outside of the slope limits.

2. Avoid compacting the bottom of the leach field excavation.

3. If the bottom of the leach field excavation is glazed or smeared by digging equipment, it must be roughened by hand-raking prior to placement of sand liner, if required.

C. Promptly begin backfill operations, but not before completing the following:

1. As-built locations of pipes for record documents.

2. Inspecting and testing pipes as described in Pipes and Fittings, Part 3.04.F.

3. Removing trash and debris.

4. Removing temporary shoring, bracing and sheeting.

D. Shape bedding course to provide continuous support for bells, joints and barrels of pipes.

E. Compact backfill to the density requirements shown, as measured in accordance with ASTM D 1557.

F. Final grading of finished surfaces will provide positive drainage away from the septic improvements.

G. Excess excavated material may be incorporated into on-site fill areas.

3.3 FILTER FABRIC

A. Smooth top surface of sewer rock before placing filter fabric.

B. Lay filter fabric parallel with long axis of trench. Overlap sections by a minimum of 3 feet. If filter fabric is torn, overlay new filter fabric with a minimum 3-foot overlap around the edges of the torn area. Ensure that the patch remains in place with material is placed over the affected area.

C. When placing cover material on filter fabric, maintain a minimum of 12 inches of material at all times between the fabric and construction equipment.

3.4 PIPES AND FITTINGS

A. Delivery, Storage and Handling

1. Do not store plastic structures, pipe and fittings in direct sunlight.

2. Protect pipe, fittings and seals from dirt and damage.

B. Drawing plans and details indicate location and arrangement of underground piping. Install piping as indicated. Notify engineer if conflicts with other utilities require modifications.

C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Leach field laterals must be laid flat. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves and couplings according to manufacturer's instructions and using lubricants, cements and other installation materials as required. Maintain swab or drag in line, and pull past each joint as it is completed.

D. Use properly sized increasers, reducers and couplings where different sizes of pipes and fittings are connected.

E. Field Quality Control:

1. Use care when backfilling pipe such that line displacement, crushing, or other damage does not occur.

2. Perform testing as required in 3.04.F.

3. Repair all crushed, broken, cracked or otherwise damaged piping.

4. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

5. Re-inspect and repeat procedure until results are satisfactory.

F. Testing

1. Perform a hydrostatic exfiltration test on the non-perforated pipe section. Maintain a minimum head of 6 feet of water above the crown at the upper end of the test section for a minimum of four hours. Thereafter, observe the loss rate for a one-hour period for the actual test of leakage. During this one-hour period, the measured loss shall not exceed the rate of 50 gallons per inch diameter per mile per 24 hours.

2. Submit report to the Engineer for approval.

3. Replace leaking piping using new materials and repeat testing until leakage is within specified allowances.

4. Do not enclose, cover or put into service before inspection and approval test reports have been approved by the Engineer.

3.5 SEPTIC TANK

A. Install septic tank level on undisturbed soil or backfill compacted to 95% maximum density. Repair scratches or damage to tank per manufacturer's recommendations.

B. Install gravity-flow piping and connect to building's sanitary drains, of sizes and in locations as required by the building mechanical plans.

C. Install septic tank level on undisturbed soil or backfill compacted to 95% minimum relative density. Repair scratches or damage to tank per manufacturer's recommendations.

3.6 SEWER SYSTEM APPROVAL

A. After installation of the sewer system is complete, submit testing reports and record drawings to the Engineer.

B. Contractor shall submit Documentation of Construction per 18 AAC 72.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

DIVISION 40

PROCESS INTERCONNECTIONS

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 71 00 – IN-LINE LIQUID FLOW MEASURING SYSTEMS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall provide in-line liquid flow 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 parts and components shall be of a single manufactured and designed as a single system.

D. All instruments shall be FM-approved, or equal.

1.2 SUBMITTALS

A. General: Shop Drawings shall be submitted in conformance with the requirements of Section 40 90 00 – Process Control and Instrumentation Systems.

B. General:

1. Submittals shall be furnished for the purpose of evaluating bids.

2. 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.

C. Shop Drawings: Provide detail drawings of the metering body (i.e.: flow tube) for the purpose of verifying sizes, fit and application.

D. Technical Data: Provide data sheets along with operations and maintenance manuals for bid evaluation purposes.

E. Startup Services: The system manufacturer shall be locally represented having a factory-certified factory-trained service technician. The representative's technician shall provide startup services once the owner has installed the equipment. Technician credentials are to be submitted with this bid.

1. These instruments will be installed at separate locations in the Anchorage area resulting in a service trip for each installation.

2. Startup services are to include installation verification, commissioning, calibration and 1 hour of informal training.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Magnetic flow meter:

1. Badger Meter M2000 series

B. Flow switch:

1. McDonnell Miller FS7-4

2. **Or equal**

2.2 MAGNETIC FLOW METER

A. General:

1. The ultrasonic flow meters shall be comprised of a flow tube and a converter. The flow tube shall generate a measuring signal proportional to the velocity in the pipe. The converter shall convert the measuring signal into a standard 4-20 mA current output, proportional to the flow rate.

2. Flow tube and Transmitter

3. System accuracy shall be better than 0.5 percent of flow rate for velocities greater than 1.5 fps.

4. The flow meter shall be suitable for velocity range of 1.5 to 30 fps

5. Provide flow meters with enclosures suitable for the environment and in accordance with the hazardous location diagram. Minimum rating shall be NEMA 4X.

6. Provide flow tube diameters in accordance with the following schedule:

Tag No.	Location	Flow Tube Diameter
FT- 205	Bogard Station	
FT- 221	Bogard Station	

B. Materials of Construction

1. Meter shall meet the AWWA C715, C750, UL327B and FM 1044 standards

2. Housing with Flow Tube: Constructed with lead-free bronze alloy, NSF/ANSI Standard 61and 372 compliant.

3. Flow tubes shall be provided with grounding rings

4. The flow meter shall be suitable for operation at temperatures from 0° C to 80° C.

C. Transmitter:

1. The transmitter shall provide a 4-20 mA signal proportional to flow with adjustable damping. Provide a pulse output for flow totalization.

2. Power supply shall be 24 VDC.

3. Transmitter shall be located per the Drawings

2.3 Flow Switch

A. The flow switch shall be a paddle-type flow switch. The flow switch shall actuate a contact once a minimum flow is detected.

B. Materials of Construction:

1. Brass, stainless steel, PTFE.

2. NEMA 4X enclosure.

C. The flow switch shall have the following:

1. Range shall be 4.8-998gpm adjustable.

2. Maximum pressure shall be 300psi or greater.

3. Maximum temperature shall be 300ºF.

4. Two SPDP switches rated at 7.4A at 120V.

PART 3 - EXECUTION

3.1 GENERAL

A. Flow measuring systems shall be handled, installed in accordance with the Manufacturers installation instructions and calibrated, loop-tested, precommissioned, and performance tested by authorized manufacturer's representatives according to Section 40 90 00 – Process Control and Instrumentation Systems.

B. The Manufacturer shall provide 4 hours of on-site training for each type of instrument.

C. The CONTRACTOR shall cut, patch, fit, and weld fittings to existing pipes as necessary. Pipes shall be cleaned and painted to match existing pipe finish. All fittings and fixtures shall be disinfected following the standard procedure before being put into service.

END OF SECTION 40 71 00

THIS PAGE INTENTIONALLY BLANK

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.

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, remote indicator, terminal box with cover, block and bleed valves, and conduit connections. 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. Operation: Pressure applied to the unit shall be transmitted to a sensing diaphragm made of ceramic sensor or polysilicone. 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 600 psig.

3. The maximum over range pressure limit shall be a minimum of 150 percent of the minimum range.

4. Span shall be adjustable over a minimum of 5:1 range.

5. Damping shall be provided as an internal adjustment.

6. All equipment shall be suitable for an ambient operating range of minus 40 degrees F to plus 100 degrees F.

7. Integral indicators shall be calibrated in process units.

8. Power supply shall be 24 VDC, loop powered.

9. Accuracy, including linearity and repeatability, shall be a plus or minus 0.2 percent of span.

10. Any solution in the probe shall be food grade.

C. Materials: All wetted parts shall be constructed of 316 stainless steel. Exposed parts shall be stainless steel or aluminum with polyurethane coating.

D. The devices shall be smart devices that can be calibrated with a Fluke 744 HART protocol calibrator.

E. Pressure transmitter housing shall be rated for NEMA 4X.

F. Manufacturer's Gauge Pressure Transmitters: **Rosemount Model 2088**, or equal.

The following electronic gauge pressure transmitters shall be provided:

Tag No.	Location	Range (psig)	Process Connection
PIT-200	Bogard Station	Up to 4,000	
PIT-201	Bogard Station	Up to 4,000	

PART 3 - EXECUTION

3.1 GENERAL

A. Pressure measuring and control systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested according to Section 40 90 00 – Process Control and Instrumentation Systems.

B. Mounting hardware and sensing lines shall be stainless steel in accordance with Section 22 11 19 – Piping and Tubing Systems.

C. 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 locations 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.

D. 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, controller input and output wiring and other field wiring and cables shall be provided under Division 26.

3. Terminations and wire identification at PCIS equipment furnished under this or any other Division shall be provided under Division 26.

E. Instrumentation Tie-Downs: Instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements applicable to the Site.

F. 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.

G. 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.

H. 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. Flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.

5. Power and signal wires shall be terminated with crimped type lugs.

6. Connections shall be, as minimum, watertight.

7. Wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.

8. 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.

9. Mounting stands and bracket materials and workmanship shall only comply with requirements of the Contract Documents.

10. Verify the correctness of each installation, including polarity of electrical 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.

11. The OWNER will not be responsible for any additional cost of rework attributable to actions of the CONTRACTOR or the PANEL FABRICATOR.

3.2 CALIBRATION

A. General: Devices provided under Division 40 shall be calibrated according to the manufacturers' recommended procedure to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field to ensure proper operation in accordance with the instrument loop diagrams or specification data sheets.

3.3 LOOP TESTING

A. The CONTRACTOR shall coordinate with and assist the PANEL FABRICATOR and to complete the various control panel loop testing.

B. 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.

C. 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 controller. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested.

3.4 PERFORMANCE TEST

A. The CONTRACTOR shall assist and coordinate with the PANEL FABRICATOR during the complete start-up, testing and commissioning process. The CONTRACTOR shall provide proper qualified personnel to make adjustments, assist with troubleshooting, provide technical support, etc. as necessary during the commissioning process.

B. The entire PCIS hardware, field instruments, power supplies, and wiring shall operate for 30 days without failure.

C. The CONTRACTOR shall furnish support staff as required to satisfy the repair of replacement requirements.

D. If any component, other than field instruments, fails during the performance test, it shall be repaired or replaced and the PCIS shall be restarted for another 30-day period.

3.5 FINAL ACCEPTANCE TEST

A. Once all equipment and subsystem tests have been complete and results accepted by the ENGINEER, the complete PCIS system shall be put into service for a Final Acceptance Test. The OWNER and ENGINEER shall be notified a minimum of 48 hours prior to the start of the test.

B. The entire PCIS system control panels hardware, field instruments, power supplies, and wiring shall operate in accordance with the Specifications and Functional Narrative for 30 days without failure.

C. If any component, other than field instruments, fails during the final acceptance test, it shall be repaired or replaced and the PCIS shall be restarted for another 30-day period.

D. The CONTRACTOR shall furnish support staff as required to satisfy the repair or replacement requirements.

3.6 REQUIREMENTS FOR SUBSTANTIAL COMPLETION

A. For the purpose of this Section, the following shall be fulfilled before the WORK is considered substantially complete:

1. Submittals have been completed and approved.

2. The PCIS has been installed, calibrated, and loop tested.

3. Spare parts and expendable supplies and test equipment have been delivered to the ENGINEER.

4. The performance test has been successfully completed.

5. Punch-list items have been corrected.

6. Record drawings in both hard copy and electronic format have been submitted.

7. Revisions to the Technical Manuals that may have resulted from the field tests have been made and reviewed.

8. Debris associated with the installation of instrumentation has been removed.

9. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

END OF SECTION 40 73 00

SECTION 40 74 00 – TEMPERATURE MEASURING SYSTEMS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall provide temperature 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. A single or dual channel water quality sensor transmitter with a local user interface AND the ability to access sensor data through a remotely mounted indication display and through the SCADA Control Panel (SCP) HMI.

D. Provide labor, material, equipment, related services, and supervision to install and operate the controller to drawings and manufacturer's specifications.

1.2 CERTIFICATIONS

A. Listed for use in general locations to UL and CSA safety standards by ETL (with all sensor types).

1.3 WARRANTY

A. Warranted for 1 year from date of shipment from manufacturer defects.

1.4 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 Division 01.

PART 2 - PRODUCTS

2.1 INSERTION-TYPE TEMPERATURE SENSORS

A. Insertion type Resistor Temperature Sensors (RTSs) shall be 100 ohms nominal at 0 degree C, tip-sensitive, three-wire platinum in 0.25-inch Type 316 stainless steel sheath with watertight potting. Time constant in agitated water shall not exceed 6.0 seconds. Equipment shall comply with International Practical Temperature Scale (IPTS)-68 standards. Accuracy shall be plus or minus 0.1-degree C. Temperature transmitters shall be 2-wire devices with continuously

adjustable span and zero adjustments, solid state circuitry, and a 4-20 mA DC output linearly proportional to the indicated temperature span. Where indicated with thermowells, RTSs shall be provided with 316 stainless steel thermowell, spring-loading device, extensions, union coupler, aluminum connection head. The Union shall extend out beyond the pipe lagging.

B. Components: Electronic transmitters and sensor shall consist of a capsule assembly, process connector and connection, amplifier unit, remote indicator, terminal box with cover, block and bleed valves, and conduit connections. Each transmitter installation shall include a location as shown on the drawings.

C. Insertion-type transmitter housing shall be rated for NEMA 4X.

D. Materials: All wetted parts shall be constructed of 316 stainless steel. Exposed parts shall be stainless steel or aluminum with polyurethane coating.

E. 2-wire design providing 4-20mA HART

F. Insertion-type LCD display mounted remotely on instrumentation rack.

G. Devices provided:

Tag No.	Location	Temp Range (F)	Note
TT-100	Bogard Station	+20 to 120	
TT-231	Bogard Station	-20 to 185	

2.2 MANUFACTURER

A. Insertion Type Temperature Sensor

1. Transmitter: Rosemount 644HAE5J6M5F6Q4

2. Temperature element: As required for installation.

B. Indoor Ambient Temperature Transmitter

1. Dwyer BTT-NOO-3

PART 3 - EXECUTION

3.1 GENERAL

A. Temperature measuring and control systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested according to Section 40 90 00 – Process Control and Instrumentation Systems.

3.2 PREPARATION

A. Mounting

1. Mount the controller in the location shown on the drawings.

2. Insertion type sensor should be mounted in accordance with the manufacturer's requirements.

3.3 INSTALLATION

A. Install controller following transmittal drawings and instrument user manual.

END OF SECTION 40 74 00

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 90 00 – PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all Process Control and Instrumentation Systems (PCIS), and required programming, complete and operable, in accordance with the Contract Documents.

B. The requirements of this Section apply to all components of the PCIS, unless indicated otherwise.

C. Responsibilities

1. The CONTRACTOR, 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.

D. Control System Panel Designer and Fabricator

1. Control System Panel Designer and Fabricator (CSPDF): The control system panel, and all other panels that have PLC hardware or communication hardware within them, shall be fabricated by the CSPDF. The CSPDF shall perform the following work:

   a. Edit contract loop drawings and control panel designs to show any and all changes to the design.

   b. Fabricate and Test the panel(s) at the factory.

   c. Ship the panel with a copy of the marked up drawings.

2. CSPDF Qualifications: The CSPDF shall have the resources, space, and personnel needed to design and fabricate the panels. The CSPDF shall meet the following minimum qualifications:

   a. The CSPDF shall have been in the business of building panels and bonding the construction of these panels for at least 5 years. The bonding shall be under the name and ownership of the company fabricating the panels for this project.

   b. The CSPDF shall build the panels to UL standard 508A, shall be certified to build panels to UL standard 508A, and shall attach a UL label on all new panels, or the panel builder shall build to an equal standard, shall be certified to an equal standard, and shall attach a label to all new panels with a label that is acceptable to the City of Palmer.

   c. The CSPDF shall make all wiring changes to new and existing control panels. The changes shall be made to UL standard 508, or equal standard that is acceptable to the City of Palmer. The CSPDF shall provide a UL engineer, or equal testing lab engineer that is acceptable to the City of Palmer, to inspect the changes and certify that the panel meets the standard, or provide a list of deficiencies.

3. Acceptable OEM Manufacturers include:

   a. Koniag Water & Energy / TecPro, Wasilla, Alaska

PART 2 - LOCAL CONTROL STATIONS AND MISCELLANEOUS ELECTRICAL DEVICES

2.1 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with City of Palmer Standard Specifications, Section 26 05 00 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 Division 01.

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 A – Edited As-Built Drawings

b. Section B – Instrument Summary

c. Section C – Instrument Data Sheets

d. Section D – Instrument Installation Details

e. Section E – Test Results

3. Signed results from Loop Testing and 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.

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.

2.2 WARRANTY

A. The warranty shall start from the date of final acceptance of the completed project, and shall extend for 1 year.

PART 3 - PRODUCTS

3.1 GENERAL

A. Code and Regulatory Compliance: PCIS WORK shall conform to or exceed the applicable requirements of the National Electrical Code and local building codes.

B. Current Technology: Meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the Shop Drawings, unless otherwise required to match existing equipment.

C. Hardware Commonality: Instruments which utilize a common measurement principle (for example, d/p cells, pressure transmitters, level transmitters which monitor hydrostatic head) shall be furnished by a single manufacturer. Panel-mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single manufacturer.

D. Loop Accuracy: The accuracy of each instrumentation system or loop shall be determined as a probable maximum error; this shall be the square root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of plus and minus 2 percent of full scale and a minimum repeatability of plus and minus 1 percent of full scale when installed in the field, unless otherwise indicated. Instruments that do not conform to or improve upon these criteria are not acceptable.

E. Instrument and Loop Power: Power requirements and input/output connections for all components shall be verified. Power for transmitted signals shall, in general, originate in and be supplied by the control panel devices. The use of "2-wire" transmitters is preferred, and use of "4-wire" transmitters shall be minimized. Individual loop or redundant power supplies shall be provided as required by the manufacturer's instrument load characteristics to ensure sufficient power to each loop component. Power supplies shall be mounted within control panels or in the field at the point of application.

F. Loop Isolators and Converters: Signal isolators shall be provided as required to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component. Dropping precision wirewound resistors shall be installed at all field side terminations in the control panels to ensure loop integrity. Signal conditioners and converters shall be provided where required to resolve any signal level incompatibilities or provide required functions.

G. Environmental Suitability: Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. The CONTRACTOR shall provide power wiring for these devices. Enclosures suitable for the environment shall be furnished. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

H. Signal Levels: Analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable. Electrical signals outside control panels shall be 4 to 20 mA DC, except as indicated. Signals within enclosures may be 1 5 VDC. Electric signals shall be electrically or optically isolated from other signals. Pneumatic signals shall be 3 to 15 psig, with 3 psig equal to 0 percent, and 15 psig equal to 100 percent.

I. Alternative Equipment and Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the ENGINEER through the "or equal" process. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available. To match existing equipment and future equipment being installed under other contracts, equipment substitutions for equipment specified as no equal will not be accepted.

J. Instrument Brackets and Mounting Hardware: All instrument brackets and mounting hardware shall be stainless steel.

3.2 OPERATING CONDITIONS

A. The PCIS shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:

1. Environment - water treatment/supply facility

2. Indoor Temperature Range - 32 through 84 degrees F

3. Relative Humidity - 20 through 90 percent, non-condensing

4. Seismic Zone 4

3.3 SPARE PARTS AND SPECIAL TOOLS

A. The CONTRACTOR shall provide the following:

1. Spare parts as listed in equipment specifications in Division 40.

B. The CONTRACTOR shall furnish a priced list of all special tools required to calibrate and maintain the instrumentation provided under the Contract Documents. After approval, the CONTRACTOR shall furnish tools on that list.

C. Special tools and spare parts shall be submitted before startup commences, suitably wrapped and identified.

PART 4 - EXECUTION

4.1 PRODUCT HANDLING

A. Shipping Precautions: After completion of shop assembly, factory test, and approval, equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the Site.

B. Special Instructions: Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

C. Tagging: Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel tag firmly attached and stamped with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the PCIS. Identification shall be prominently displayed on the outside of the package. Each HART device shall have the PID number programmed into smart HART protocol memory. The complete tag shall be the instrument drawing tag shown on the contract drawings.

D. Storage: Equipment shall not be stored outdoors. Equipment shall be stored in dry, permanent shelters, including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through tests as directed by the ENGINEER. If such tests reveal defects, the equipment shall be replaced.

4.2 INSTALLATION

A. General

1. Instrumentation, including instrumentation furnished under other Divisions, shall be installed under Division 40 and the manufacturers' instructions.

2. Equipment Locations: The monitoring and control system configurations indicated are diagrammatic. The locations of equipment are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the OWNER exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the CONTRACTOR shall make such changes without additional cost to the OWNER.

B. Conduit, Cables, and Field Wiring

1. Conduit shall be provided under Division 26.

2. Process equipment control wiring, 4-20 mA signal circuits, signal wiring to field instruments, PLC input and output wiring and other field wiring and cables shall be provided under Division 26.

3. 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. Flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.

5. Power and signal wires shall be terminated with crimped type lugs.

6. Connectors shall be, as a minimum, watertight.

7. Wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.

8. 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.

9. Fasteners using adhesives are not permitted.

10. Mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.

11. Verify the correctness of each installation, including polarity of electric power and signal connections, and make sure process connections are free of leaks. The CONTRACTOR shall certify in writing that discrepancies have been corrected for each loop or system checked out.

12. The OWNER will not be responsible for any additional cost of rework attributable to actions of the CONTRACTOR or the Instrumentation Supplier.

4.3 CALIBRATION

A. General: Devices provided under Division 40 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Calibration Points: Each instrument shall be calibrated at 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.

4.4 LOOP TESTING

A. General: Individual instrument loop diagrams per ISA Standard S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the ENGINEER for review prior to the loop tests. The 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.

4.5 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.

4.6 REQUIREMENTS FOR SUBSTANTIAL COMPLETION

A. For the purpose of this Section, the following conditions, 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.

END OF SECTION 40 90 00

SECTION 40 95 00 – PLC-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 PLC-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 suitable 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, as required to support the SCADA Control Panel (SCP) and System.

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-L30ER**, as shown on the Drawing, no exceptions, to match other 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: As recommended by the manufacturer, and in accordance with industry standards.

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.

3. DC input for devices that operate at 5 to 30 VDC.

4. 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.

5. DC output for devices that operate at 10 to 30 VDC.

6. 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.

7. 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.

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 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 PanelView Plus 700 Standard 2711P**, or equal.

2.5 NETWORK HARDWARE

A. All unshielded twisted pair cabling shall be rated EIA/TIA 568 category 6A for plenum space.

B. DIN Rail-mounted Ethernet Switch (POE and GB): 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 **KORENIX JET NET 3810G and 3008G**, or equal.

C. EtherNet Tap Module: Allen-Bradley 1783-ETAP.

2.6 SPARE PARTS

A. Provide one card, power supply, 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 necessary equipment 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 budgeted 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 $225 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 40 95 00

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 95 13 – CONTROL PANELS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall provide 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.

D. Control and SCADA panels shall be built to UL 508, or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction. The panels shall have UL labels attached to them by the panel builder. The panel builder shall provide with each panel a certification from the independent testing lab inspector that the panel is built to their standards.

E. Panels equipped with Intrinsically Safe controls shall also bear UL 913 label in addition to the UL 508.

F. Control and power panel enclosures shall be built to NEC standards for enclosures.

1.2 REFERENCE DOCUMENTS

A. UL 508A – 2001 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 Division 01 Requirements and Section 26 05 00.

B. Control Panel Engineering Submittal: The CONTRACTOR shall submit a control panel engineering submittal (CPES) for each control panel and enclosure provided under Division 40. The CPES shall completely define and document the construction, finish, fuses, circuit breakers, internally-mounted hardware, communications hardware, and 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.

5. 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.

6. 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 necessary 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. The control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel. 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 exterior control panels and enclosures mounted above ground level, unless noted otherwise on the Drawings, shall be NEMA 4X with rain shield across top of doors.

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.

C. Weatherproof NEMA 3R Enclosures: Large, weatherproof enclosures, 4 feet high or higher, shall be built to NEMA 4 standards and shall be rated for outdoor use in wet environments. The enclosures shall be built of 12ga steel to the size shown on the Drawings, and have the following features:

1. Fully gasketed single or double door access as shown on the Drawings, with removable post.

2. Seams continuously welded.

3. Lifting eyes.

4. 3-point latching pad lockable handle on each door.

5. Rollers for the latching rods for 3-point latch.

6. Back panels (full size).

7. Insulation.

8. Open bottom with 2” flange for pad mounting.

9. Provision for mounting fluorescent lights.

10. Enclosures shall be Hoffman, or equal.

D. Fabrication

1. 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.

2. 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.

E. 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.

F. 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.

b. The surfaces shall be sanded or sandblasted to a smooth, clean, bright finish.

c. All traces of oil shall be removed with a solvent.

d. The first coat of primer shall be applied immediately.

G. 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.

H. 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.

I. 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 60 watt incandescent T-10 style light fixture, as shown on the Drawings. The fixture shall include a 120-volt receptacle and door switch. The fixture shall be **Hoffman model A-LTDB1**, or equal.

5. Each panel shall be provided with a switched light fixture, as shown on the Drawings. The fixture shall include a 120-volt receptacle and door switch.

6. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise indicated.

7. Signal and Control Circuit Wiring

   a. Wire type and sizes: Conductor shall be flexible stranded copper wire, UL. Wires for instrument signal circuits and alarm input circuits shall be No. 16 AWG Type MTW rated for 300 volts. The analog cables between the PLC I/O card and terminal strips shall be (8) conductor No. 18 AWG cable rated 300 volts for loop powered devices and 8-pair shielded No. 18 AWG cable rated 300 volts for 4-wire loops. 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

      All 120 VAC power wiring protected by the main circuit breaker and incoming power service shall be No. 12 AWG.

   c. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from heat shrink plastic. Wires shall be marked as shown on the Drawings. Numbers shall read from left to right.

   d. Flexible conduit is only to be used where specified.

   e. Conduit fittings shall be **Crouse Hinds cast fittings**, or equal.

   f. For equipment grounding, panels shall be provided with a 1/4 inch by 1 inch copper ground bus complete with solder-less connector for one No. 4 AWG bare stranded copper cable. The copper cable shall be provided by the CONTRACTOR and be connected to the electrical equipment ground of the 120-volt panel supplying power.

8. 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.

   c. When instruments do not come equipped with integral fuses, provide fuses as required for the protection of individual instruments against fault currents. Fuses shall be mounted on the back of the panel in a fuse holder, and each fuse shall be identified by a service name tag. Fuses shall be as manufactured by **Bussmann Manufacturing Division, Type KAW TRON**, or equal. Circuit breakers shall be provided as shown on the Drawings.

J. 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. Relays shall be **Siemens 3TX7110-5JC03** with **3TX7144-1E7** socket.

3. Intrinsic Safety Relay: The intrinsic safety relay shall provide isolation of 2-wire 24 VDC circuits in a hazardous location. 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. The relays shall be **Turck model IM33**, or equal. The safety relays for 24Vdc discrete signals shall be **Turck Model IM1-22EX-R**, or equal.

K. 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 blow 250-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**.

L. Spare Fuses: For each panel, provide the following spare fuses:

1. A minimum of two spare fuses of each size

2. One spare fuse for every ten fused circuits

Provide the fuses in a spare fuse box mounted on the interior wall of the panel. Fuse box shall be **Plano Tackle Systems 1061 Accessory Box, Plano, IL**, **www.planomolding.com**, or equal.

M. Power Supply 24 VDC: Each panel shall be supplied from a battery-backed 24 VDC power supply. Each power supply module shall include a DC-OK relay contact that shall be wired to a discrete input card. The power supply shall meet the requirements of Section 26 33 05.

N. The DC power supply shall be a **SENS model Q 024-025-T-L-511-C**, or equal. The batteries shall be 24 V sealed lead acid rated at 103Ah at the 10 hour rate. Batteries are to be (2) units of the **Powersonic Battery model PS-121100**, or equal.

O. DC-DC Converters: Where 0-5 VDC is required a DC to DC converter shall be provided. The converter is to be provided with an overload protection function that protects the load and the power supply from possible damage by over current. When the output current rises above 105% of the rated output current, the protection function is to be triggered decreasing the output voltage. When the output current falls within the rated range, the overload protection function is to be automatically cleared. The DC-DC converter shall be **Omron model S82S-7305**, or equal.

P. 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.

Q. Intrinsic Safety Relay: The intrinsic safety relay shall provide isolation of 2-wire 24 VDC circuits in a hazardous location. 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. The relays shall be Turk model MK33, or equal.

R. Miscellaneous Parts:

1. 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..

2. 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.

3. Cabinet heater shall be a forced air ventilation enclosed heater with 450-watt wire wound heating element, 120 VAC power cord and cap, creep action thermostat set for 40 degrees F on and 60 degrees F off, enclosed in a metal housing. The unit shall be a UL-listed

device suitable for installation in non-UL-listed enclosures. The unit shall be Hi Heat Industries Inc. Model E040100A8, or equal.

4. Incandescent lighting package with integral door switch and convenience receptacle. Provide mounting spacers as required.

S. 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. Control panels shall be marked with the following information that is plainly visible after installation:

1. Manufacturer's name

2. Supply voltage

3. Short-circuit rating of the main breaker

4. Name of the project and site

5. Enclosure rating

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 to control panels 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. Enclosures Wiring: All wiring shall be run in liquidtight flexible conduit (LFMC), unless otherwise noted on the Drawings. All enclosure wiring and raceways shall be installed by the panel builder in the shop.

D. Wiring to rear terminals on panel mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

E. Shop Drawings shall show conformance to the above wiring installation requirements.

F. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number as shown on the Contract Drawings. These numbers shall be marked on all conductors at every terminal.

3.4 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

a. 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.

b. All status, control, analog and alarm circuits rung out to determine their operability.

c. All electrical power circuits checked for continuity and where applicable, operability.

d. 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 40 95 13

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

III

SUBMITTAL LIST

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

SUBMITTAL LIST

Job #: _____ Contractor: _____

Submittal Number	Rev.	Description
1		DOL Notice of Public Work
2		Proposed Disposal Sites
3		List of Construction Equipment
4		Construction Schedule and Updates
5		Schedule of Values
6		Submittal Register
7		List of Substitutions
8		Application for Payment – Progress and Final
9		Bi-weekly Certified Payroll
10		Safety Plan
11		Contractor's Quality Control Plan
12		Contractor's Quality Control Testing Results
13		Startup Plan
14		Record Drawings
15		DOL Notice of Completion of Public Work
16		Release of Liens, Statement Concerning Claims
17		Certificate of Compliance (Section 10.07, Article 7.7)
18		Consent of Surety to Final Payment
19		Contract Completion and Acceptance Certificate
		See Technical Specifications for Required Product Data and Quality Control Submittals

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, specifications, CPSS, or as directed by the Engineer.

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

IV

TEMPORARY CONSTRUCTION PERMITS AND EASEMENTS

(NOT USED)

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

V

EQUAL OPPORTUNITY BIDDING AND REPORTING REQUIREMENTS

(NOT USED)

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

VI

MBE/WBE SPECIFICATIONS

(NOT USED)

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

VII

MINIMUM RATES OF PAY

EXHIBIT A - STATE OF ALASKA TITLE 36 WAGE RATES

THIS PAGE INTENTIONALLY LEFT BLANK

Laborers' & Mechanics' Minimum Rates of Pay

Labor for the project must be paid at the prevailing wage rates listed in the Alaska Department of Labor & Workforce Development, Laborers' & Mechanics' Minimum Rates of Pay, Wage & Hour Administration Pamphlet no 600.

The state of Alaska wage rates can be obtained at:

http://www.labor.state.ak.us/lss/pamp600.htm

Use the rates that are in effect ten days prior to Bid Opening.

A paper copy of the wage rates will be included in the executed Contract.

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

VIII

CONTRACT

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

CONSTRUCTION CONTRACT

THIS CONTRACT, between the **City of Palmer,** herein called the **Owner,** and:

_____, an Individual, Partnership, Joint Venture, Sole Proprietorship, Corporation, incorporated under the laws of the State of Alaska, its successors and assigns, hereinafter called the Contractor, is effective the date of the signature of the Owner on this document.

WITNESSETH: That the Contractor, for and in consideration of the payment or payments herein specified and agreed to by the City, hereby covenants and agrees to furnish and deliver all materials and to do and perform all the work and labor required in the construction of the **Bogard Road Booster Station,** at the prices bid by the Contractor for the respective estimated quantities aggregating approximately the sum of:

_____ Dollars ($_____), and such other items as are mentioned in the original Proposal, which Proposal and prices named, together with the Contract Documents, and City of Palmer Standard Specifications for Streets, Drainage and Utilities dated **MONTH, YEAR** are made a part of this Contract and accepted as such, the project being situated as follows:

North side of Bogard Road, approximately 1 mile west of Palmer High School as more particulary described in the Contract Documents.

It is distinctly understood and agreed that no claim for additional work or materials, done or furnished by the Contractor and not specifically herein provided for, will be allowed by the Owner, nor shall the Contractor do any work or furnish any material not covered by this Contract, unless such work is ordered in writing by the Owner. In no event shall the Owner be liable for any materials furnished or used, or for any work or labor done, unless the materials, work or labor are required by the Contract or on written order furnished by the Owner. Any such work or materials which may be done or furnished by the Contractor without written order first being given shall be at the Contractor's own risk, cost and expense and the Contractor hereby covenants and agrees to make no claim for compensation for work or materials done or furnished without such written order.

The Contractor further covenants and agrees that all materials shall be furnished and delivered and all labor shall be done and performed, in every respect, to the satisfaction of the Owner, on or before: _____. It is expressly understood and agreed that in case of the failure on the part of the Contractor, for any reason, except with the written consent of the Owner, to complete the furnishing and delivery of materials and the doing and performance of the work before the aforesaid date, the Owner shall have the right to deduct from any money due or which may become due the Contractor, or if no money shall be due, the Owner shall have the right to recover

_____dollars ($_____) per day for each calendar day elapsing between the time stipulated for the completion and the actual date of completion in accordance with the terms hereof; such deduction to be made, or sum to be recovered, not as a penalty but as liquidated damages.

The bonds given by the Contractor in the sum of $_____ Payment Bond, and $_____ Performance Bond, to secure the proper compliance with the terms and provisions of this contract, are submitted herewith and made a part hereof.

IN WITNESS WHEREOF, the parties hereto have executed this Contract and hereby agree to its terms and conditions

CONTRACTOR

_____
Name of Contractor

_____ _____
Signature Date

_____
Name and Title

(Corporate Seal)

CITY OF PALMER

_____ _____
CITY MANAGER (Signature) Date

_____
Typed Name

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

IX

CONTRACT PERFORMANCE AND PAYMENT BOND

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

That_____ of _____ as Principal, and _____ of _____ as Surety, firmly bound and held unto the _____ in the penal sum of _____ Dollars ($_____), good and lawful money of the United States of America for the payment whereof, well and truly to be paid to the _____, we bind ourselves, our heirs, successors, executors, administrators, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the said Principal has entered into written contract with said _____, on the _____ of _____ A.D. 20___, for construction of: **Bogard Road Booster Station**, said work to be done according to the terms of said contract.

Now, THEREFORE, the conditions of the foregoing obligations is such that if the said Principal shall well and truly perform and complete all obligations and work under said contract and if said principal shall reimburse upon demand of the **City of Palmer** any sums paid to him which exceed the final payment determined to be due upon completion of the project, then these presents shall become null and void; otherwise they shall remain in full force and effect.

IN WITNESS WHEREOF, we have hereunto set our hands and seals at _____, this _____ day of _____ A.D., 20___.

_____

Principal:

By:_____

By:_____

_____

Surety:

By: _____

By: _____

_____

The offered bond has been checked for adequacy under the applicable statutes and regulations:

_____ _____

Authorized Representative – City of Palmer Date

INSTRUCTIONS

1. This form, shall be used whenever a performance bond is required. There shall be no deviation from this form without approval from the Owner.

2. The full legal name and business address of the Principal and Surety shall be inserted on the face of the form. Where more than a single surety is involved, a separate form shall be executed for each surety.

3. The penal amount of the bond, or in the case of more than one surety, the amount of obligation shall be entered in words and in figures.

4. Where individual sureties are involved, a completed Affidavit of Individual Surety shall accompany the bond. Such forms are available upon request from the Owner.

5. The bond shall be signed by authorized persons. Where such persons are signing in a representative capacity (e.g. an attorney-in-fact), but is not a member of the firm, partnership, or joint venture, or an officer of the corporation involved, evidence of authority must be furnished.

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

That_____of_____as Principal, and_____of_____as Surety, firmly bound and held unto the _____ in the penal sum of _____Dollars ($_____), good and lawful money of the United States of America for the payment whereof, well and truly to be paid to the _____, we bind ourselves, our heirs, successors, executors, administrators, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the said Principal has entered into written contract with said_____, on the_____of_____A.D. 20____, for construction of: **Bogard Road Booster Station**, said work to be done according to the terms of said contract.

Now, THEREFORE, the conditions of the foregoing obligations is such that if the said principal shall comply with all requirements of law and pay, as they become due, all just claims for labor performed and materials and supplies furnished upon or for the work under said contract, whether said labor be performed and said materials and supplies be furnished under the original contract, any subcontract, or any and all duly authorized modifications thereto, then these presents shall become null and void; otherwise they shall remain in full force and effect.

IN WITNESS WHEREOF, we have hereunto set our hands and seals at_____, this_____day of_____A.D., 20____.

Principal: _____

By:_____

By:_____

Surety: _____

By: _____

By: _____

The offered bond has been checked for adequacy under the applicable statutes and regulations:

_____ _____

Authorized Representative Date
City of Palmer

INSTRUCTIONS

1. This form, for the protection of persons supplying labor and material, shall be used whenever a payment bond is required. There shall be no deviation from this form without approval from the Owner.

2. The full legal name and business address of the Principal and Surety shall be inserted on the face of the form. Where more than a single surety is involved, a separate form shall be executed for each surety.

3. The penal amount of the bond, or in the case of more than one surety, the amount of obligation shall be entered in words and in figures.

4. Where individual sureties are involved, a completed Affidavit of Individual Surety shall accompany the bond. Such forms are available upon request from the Owner.

5. The bond shall be signed by authorized persons. Where such persons are signing in a representative capacity (e.g. an attorney-in-fact), but is not a member of the firm, partnership, or joint venture, or an officer of the corporation involved, evidence of authority must be furnished.

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

X

CERTIFICATE OF INSURANCE

(submit original certificate)

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

XI

BID BOND

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

Construct Bogard Road Booster Station

BID BOND

(See Instructions on Reverse)

	DATE BOND EXECUTED
PRINCIPAL (Legal name and business address)	TYPE OF ORGANIZATION ○ INDIVIDUAL ○ PARTNERSHIP ○ JOINT VENTURE ○ CORPORATION
	STATE OF INCORPORATION

SURETY(IES) (Name and Business Address)		
A.	B.	C.
PENAL SUM OF BOND		DATE OF BID

We, the PRINCIPAL and SURETY above named, are held and firmly bound to the City of Palmer, in the penal sum of the amount stated above, for the payment of which sum will be made, we bind ourselves and our legal representatives and successors, jointly and severally, by this instrument.

THE CONDITION OF THE FOREGOING OBLIGATION is that the Principal has submitted the accompanying bid or proposal in writing, date as shown above, on **PROJECT: <u>Construct Bogard Road Booster Station</u>** in accordance with contract documents filled in the office of the Contracting Officer, and under the Invitation for Bids therefore, and is required to furnish a bond in the amount stated above.

If the Principal's bid is accepted and he is offered the proposed contract for award, and if Principal fails to enter into the contract, then the obligation to the State created by this bond shall be in full force and effect.

If the Principal enters into the contract, then the foregoing obligation is null and void.

PRINCIPAL				
Signature(s)	1.	2.	3.	Corporate Seal
Name(s) & Titles (Typed)	1.	2.	3.	

CORPORATE SURETY(IES)				
SURETY A	Name of Corporation		State of Incorporation	Liability Limit $
	Signature(s)	1.	2.	Corporate Seal
	Name(s) & Titles (Typed)	1.	2.	

CORPORATE SURETY(IES) (Continued)				
SURETY B	Name of Corporation		State of Incorporation	Liability Limit $
	Signature(s)	1.	2.	Corporate Seal
	Name(s) & Titles (Typed)	1.	2.	

CORPORATE SURETY(IES) (Continued)				
SURETY C	Name of Corporation		State of Incorporation	Liability Limit $
	Signature(s)	1.	2.	Corporate Seal
	Name(s) & Titles (Typed)	1.	2.	

INSTRUCTIONS

1. This form shall be used whenever a bid bond is submitted.
2. Insert the full legal name and business address of the Principal in the space designated. If the Principal is a partnership or joint venture, the names of all principal parties must be included (e.g. "Smith Construction, Inc. and Jones Contracting, Inc. DBA Smith/Jones Builders, a joint venture"). If the Principal is a corporation, the name of the state in which incorporated shall be inserted in the space provided.
3. Insert the full legal name and business address of the Surety in the space designated. The Surety on the bond may be any corporation or partnership authorized to do business in Alaska as an insurer under AS.21.09. Individual sureties will not be accepted.
4. The penal amount of the bond may be shown either as an amount (in words and figures) or as a percent of the contract bid price (a not-to-exceed amount may be included).
5. The scheduled bid opening date shall be entered in the space marked Date of Bid.
6. The bond shall be executed by authorized representatives of the Principal and Surety. Corporations executing the bond shall also affix their corporate seal.
7. Any person signing in a representative capacity (e.g., an attorney-in-fact) must furnish evidence of authority if that representative is not a member of the firm, partnership, or joint venture, or an officer of the corporation involved.
8. The states of incorporation and the limits of liability of each surety shall be indicated in the spaces provided.
9. The date that bond is executed must not be later than the bid opening date.

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

XII

BIDDER'S CHECKLIST

THIS PAGE INTENTIONALLY LEFT BLANK

BIDDER'S CHECKLIST

INSTRUCTIONS 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 Palmer Municipal Code.

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 four pages, BP-1 through BP-4. BP-1 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, cashiers check, money order or cash shall be submitted with the bid in the amount of 10% of the bid.

__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 Palmer Municipal Code.

__X__ Bidder Qualification Form

__X__ Subcontractors & Suppliers List

_____ MBE/WBE Compliance Statement

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

XIII

BID PROPOSAL

THIS PAGE INTENTIONALLY LEFT BLANK

BID PROPOSAL
(CERTIFICATION)

TO: CITY OF PALMER
CITY HALL
231 WEST EVERGREEN AVENUE
PALMER, ALASKA 99645

SUBJECT: Invitation to Bid No. _____

PROJECT TITLE: **Construct Bogard Road Booster Station**

Pursuant to and in compliance with subject Invitation to Bid, and other Contract 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 Contract documents at the prices established in the Bid Proposal, Page BP-2 through BP-4 submitted herewith.

The bidder agrees, if awarded the Contract, to commence and complete the Work within the time specified in the Contract documents.

The bidder acknowledges receipt of the following Addenda:

Addendum No. & Date _____ Addendum No. & Date _____
Addendum No. & Date _____ Addendum No. & Date _____
Addendum No. & Date _____ Addendum No. & Date _____

Enclosed is Bid Bond in the amount of

_____
(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 Alaska ☐ a joint venture
☐ an individual ☐ a partnership ☐ a nonprofit organization
If a partnership or joint venture, identify all parties on a separate page.

Bidder/Company Name
_____

Alaska Contractor's License Number: _____

Address of Bidder

_____

_____

Employer's Tax Identification Number: _____

Signature

Telephone Number _____

_____

CITY OF PALMER
CONSTRUCT BOGARD ROAD BOOSTER STATION
BID PROPOSAL

Summary

Schedule	Bid Amount (Figures Only)
Schedule A, Base Bid - Construct Bogard Road Booster Station	
Schedule B, Additive Alternate 1 - Pave Booster Station Pad	

TOTAL BID _____
(In Figures)

CITY OF PALMER
CONSTRUCT BOGARD ROAD BOOSTER STATION
BID PROPOSAL

Schedule A - Base Bid - Construct Bogard Road Booster Station, Complete

Item Number	Work Description	Pay Unit	Estimated Quantity	Unit Price (Figures Only)	Total Bid Price (Figures Only)
A-1	Construct Bogard Road Booster Station, Complete	Lump Sum	1		
A-2	Control System Panel Designer and Fabricator Per Specification Section 40 90 00	Lump Sum	1	$272,474.00	$272,474.00

Schedule A Total _____
(In Figures)

CITY OF PALMER
CONSTRUCT BOGARD ROAD BOOSTER STATION
BID PROPOSAL

Schedule B - Additive Alternate 1 - Pave Booster Station Pad

Item Number	Work Description	Pay Unit	Estimated Quantity	Unit Price (Figures Only)	Total Bid Price (Figures Only)
B-1	Pave Booster Station Pad	Lump Sum	1		

Schedule B Total _____
(In Figures)

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

XIV

FORMS FOR BIDDING AND CONSTRUCTION

1. BIDDER QUALIFICATION FORM
2. LIST OF SUBCONTRACTORS AND SUPPLIERS

THIS PAGE INTENTIONALLY LEFT BLANK

BIDDER QUALIFICATION FORM

The Bidder shall submit the data requested below as part of the bid package.

Contractor Business Name:_____
Business Address: _____
Years in business as contractor under above business name:_____

List six or more important or similar construction projects completed by Bidder with date, approximate cost, and name and phone number of project engineer or owner (use additional pages as required):

Project: _____
Owner: _____
Date: _____ Cost: _____
Contact Name: _____
Contact Phone: _____

Project: _____
Owner: _____
Date: _____ Cost: _____
Contact Name: _____
Contact Phone: _____

Project: _____
Owner: _____
Date: _____ Cost: _____
Contact Name: _____
Contact Phone: _____

Project: _____
Owner: _____
Date: _____ Cost: _____
Contact Name: _____
Contact Phone: _____

List other construction projects your firm will be working on or anticipate working on between April 1, 2024 and April 1, 2025. _____
_____

List major equipment to be used on this project and indicate if owned or rented:
_____

Have you received firm quotes & delivery times for major materials for this project?_____

Have you ever failed in any material way to perform your obligations under any contract with the City or other government agency? _____ If so, provide details.

_____
(signed) (title) (date)

THIS PAGE INTENTIONALLY LEFT BLANK

SUBCONTRACTORS & SUPPLIERS LIST

The Successful Bidder shall submit the data requested below by the end of the second business day following Bid opening. Use additional pages as required.

Contractor Business Name: _____

Business Address: _____

List all Subcontractors and Suppliers who will be performing more than ½ of 1% of the total cost of this project.

Business Name:_____ Trade: _____
Address: _____ Contractor's License #:_____
_____ Telephone: _____
Contact: _____ FAX: _____

Business Name:_____ Trade: _____
Address: _____ Contractor's License #:_____
_____ Telephone: _____
Contact: _____ FAX: _____

Business Name:_____ Trade: _____
Address: _____ Contractor's License #:_____
_____ Telephone: _____
Contact: _____ FAX: _____

Business Name:_____ Trade: _____
Address: _____ Contractor's License #:_____
_____ Telephone: _____
Contact: _____ FAX: _____

Business Name:_____ Trade: _____
Address: _____ Contractor's License #:_____
_____ Telephone: _____
Contact: _____ FAX: _____

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

XV

PLANS

THIS PAGE INTENTIONALLY LEFT BLANK

CITY OF PALMER

CONSTRUCT BOGARD ROAD BOOSTER STATION

XVI

GEOTECHNICAL REPORT

THIS PAGE INTENTIONALLY LEFT BLANK

GEOTECHNICAL REPORT

For

Bogard Road Booster Station
Palmer, Alaska

Prepared By:
Jeremy Dvorak, EIT
Engineering Assistant

Reviewed By:
Doug P. Simon, P.E.
Geotechnical Services Manager

HDL ENGINEERING Consultants
3335 Arctic Blvd., Ste. 100
Anchorage, AK 99503
Phone: 907.564.2120
Fax: 907.564.2122

June 6, 2017

GEOTECHNICAL REPORT

For

Bogard Road Booster Station

Prepared for:

City of Palmer

HDL Project Number 16-033

Prepared By:
Jeremy Dvorak, EIT
Engineering Assistant

Reviewed By:
Doug P. Simon, P.E.
Geotechnical Services Manager

3335 Arctic Boulevard, Suite 100
Anchorage, AK 99503
Phone: 907.564.2120
Fax: 907.564.2122

June 6, 2017

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICIES

GEOTECHNICAL REPORT
BOGARD ROAD BOOSTER STATION
PALMER, ALASKA

1.0 INTRODUCTION

This report presents the results of subsurface explorations and laboratory testing for the proposed Bogard Road Booster Station project on Bogard Road in Palmer, Alaska (Site). Included in this report are a description of the project, description and results of the subsurface explorations and laboratory testing, and geotechnical recommendations for the proposed booster station and water line extension.

The purpose of the subsurface exploration and laboratory tests were to evaluate the soil and groundwater conditions at the site. Soil samples were recovered from the borings and classified in the field by an experienced engineering assistant with HDL Engineering Consultants, LLC (HDL), and returned to our laboratory for testing. The subsurface evaluation was performed in general accordance with the procedures outlined in the Alaska Department of Transportation and Public Facilities (AKDOT&PF) "Alaska Geotechnical Procedures Manual" dated 2007.

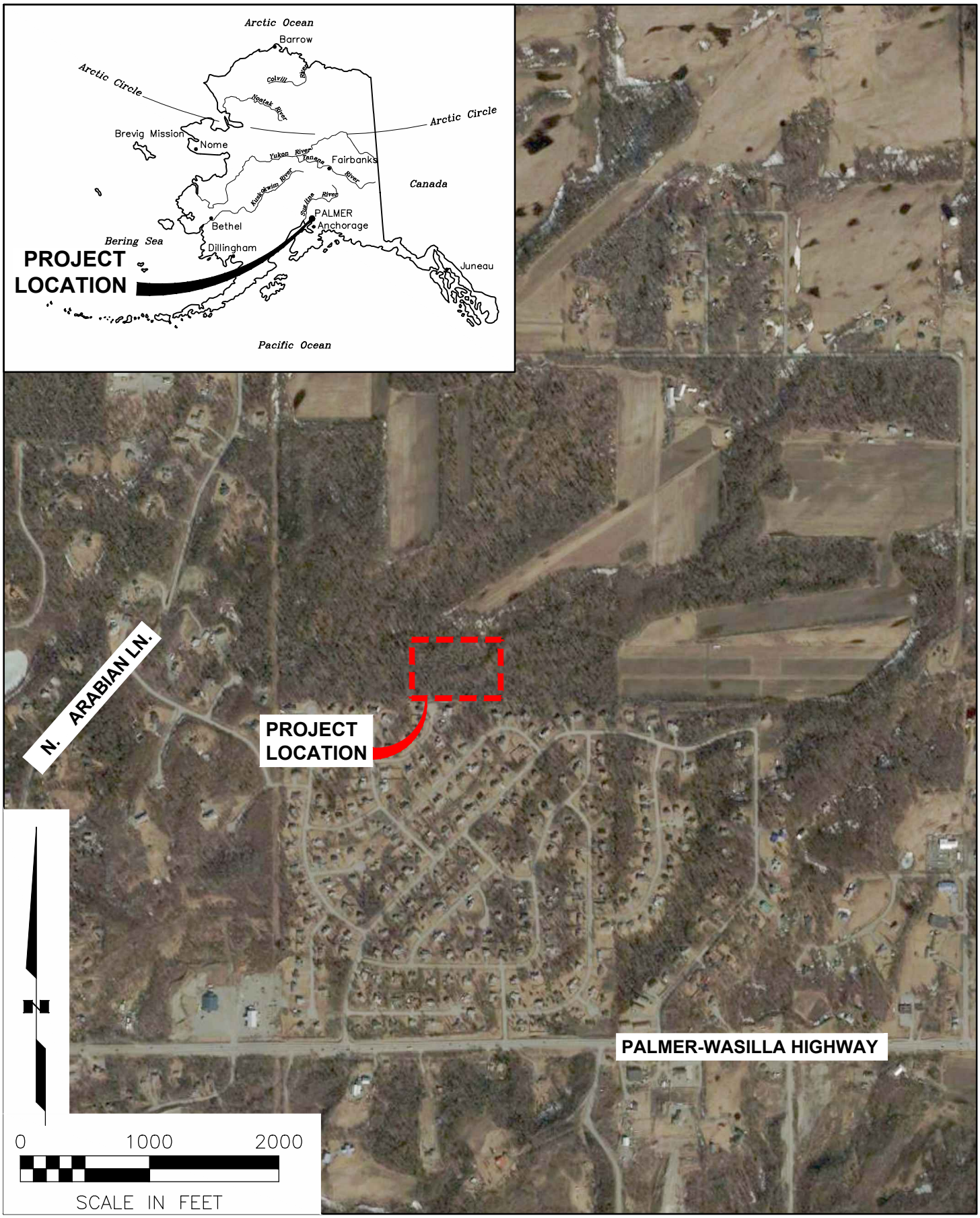
2.0 SITE AND PROJECT DESCRIPTION

The Site is located near an existing hydrant within the Matanuska-Susitna Borough (MSB) right-of-way (ROW) on the north side of Bogard Road approximately 0.4 miles east of North Arabian Lane. The approximate location of the proposed project is shown on the Vicinity Map provided as Figure 1.

In 2004, the Regulatory Commission of Alaska authorized an expansion of the Palmer Service Area for water and sewer utilities. The City of Palmer (COP) has since been working to extend the water system to meet the utility needs of the area. A recently constructed 18-inch diameter water main on Bogard Road crosses from Pressure Zone 2 into Pressure Zone 3 just east of North Arabian Lane, requiring a pressure booster station to increase the pressure to serve Pressure Zone 3. The proposed booster station will also be used to fill a future reservoir.

The proposed booster station project consists of a 32-foot by 26-foot building with a partially paved access driveway, as well as an extension of the water main. It is our understanding that the project will be completed in two phases. The first phase will consist of site preparation, utility work, pad and driveway construction. The second phase will consist of pad and driveway surfacing, and building construction. HDL assumes that the building will be supported by a shallow, spread footing foundation.

The project and subsurface descriptions presented herin are based on our current understanding of the project as of the date of this document. Modifications to the proposed building and water line extension may require further evaluation of the subsurface conditions.



H:\Jobs\16-033 Palmer Bogard Rd Booster Station (COP)\01 Geotechnical\CAD\Drawings\16-115_00_FIG-1-VINICTY, 1=1, 05-11-17 at 10:40 by jkk
LAYOUT: vicinity

CITY OF PALMER
PALMER, AK

Figure 1
VICINITY MAP
BOGARD ROAD BOOSTER STATION
PALMER, AK

3.0 SITE CONDITIONS

The following sections describe the general geology and climate of the region.

3.1 General Geology

The project area is located within the Cook Inlet-Susitna Lowlands of the Coastal Trough physiographic province of Alaska. The area is a glaciated lowland containing areas of ground moraine and stagnant ice topography, drumlin fields, eskers, and outwash plains. Most of the lowland is less than 500 feet in elevation with local relief of 50-250 feet above sea level. The Talkeetna Mountains border the province on the north and the Alaska Range lies to the north and west; to the southwest is Cook Inlet. Five major glacial advances of the Quaternary Period can be recognized in the section.

Soils in the area are typically glacially derived sands and gravels with varying fines contents. The sands and gravels are often mantled by a layer of glacially derived silt loess. Peat bogs have developed in many of the low-lying areas subsequent to the last glaciations (approximately 12,000 years ago). As the glaciers receded towards the mountains, the Susitna River, Matanuska River, and Knik River drainages were established. These drainages deposited sands and gravels in channel areas and fine grained soils in floodplains.[1]

3.2 Climatology

The project area is located in a transitional climatic zone varying between continental and maritime climates. The zone is characterized by pronounced diurnal and annual temperature variations, moderate annual precipitation, and moderate surface winds.[2] Based on data from the Western Regional Climate Center website for the City of Palmer, the mean January temperatures in the area range between 12.3°F and 23.2°F, while mean July temperatures range between 53.1°F and 67.5°F. Annual precipitation is approximately 16 inches.[3]

3.3 Seismicity

The project is located in an area of moderate seismicity and large-scale earthquakes may cause ground ruptures along the roadway. However, evaluating the locations of potential rupture zones is difficult to predict and outside the scope of this study. Slopes and structures along the road should be designed to accommodate large-scale earthquakes. The Castle Mountain Fault is located south of Houston near Big Lake. This fault is considered active and is capable of generating large magnitude earthquakes. Based on Alaska Earthquake Information Database, there were 209 events above Richter Magnitude 4 in the region from 1898 through 2010, and 43 events above a Richter Magnitude 5, of which four were Richter Magnitude 6 to 7.1.

---

[1] Wahrhaftig, Clyde. *Physiographic Divisions of Alaska.* Geological Survey Professional Paper 482. Washington, D.C. U.S. Department of the Interior. Print. 1965

[2] Martha Shulski and Gerd Wendler. University of Alaska Press. 2007. *The Climate of Alaska.*

[3] http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?akpalm

4.0 SUBSURFACE EVALUATION

HDL observed the drilling of two (2) soil borings, designated HDL-01 and HDL-02, on May 2, 2017 to evaluate the subsurface conditions within the proposed project area. The soil borings reached depths of approximately 21.5 feet and 31.5 feet below existing ground surface (bgs), respectively. Boring HDL-01 was performed near the proposed water line extension and HDL-02 was performed near the proposed booster station. Borings were located in the field using tape and line of site measurements from existing structures and ROW survey drawings. Refer to Figure 2, Boring Location Map, for the approximate locations of the soil borings.

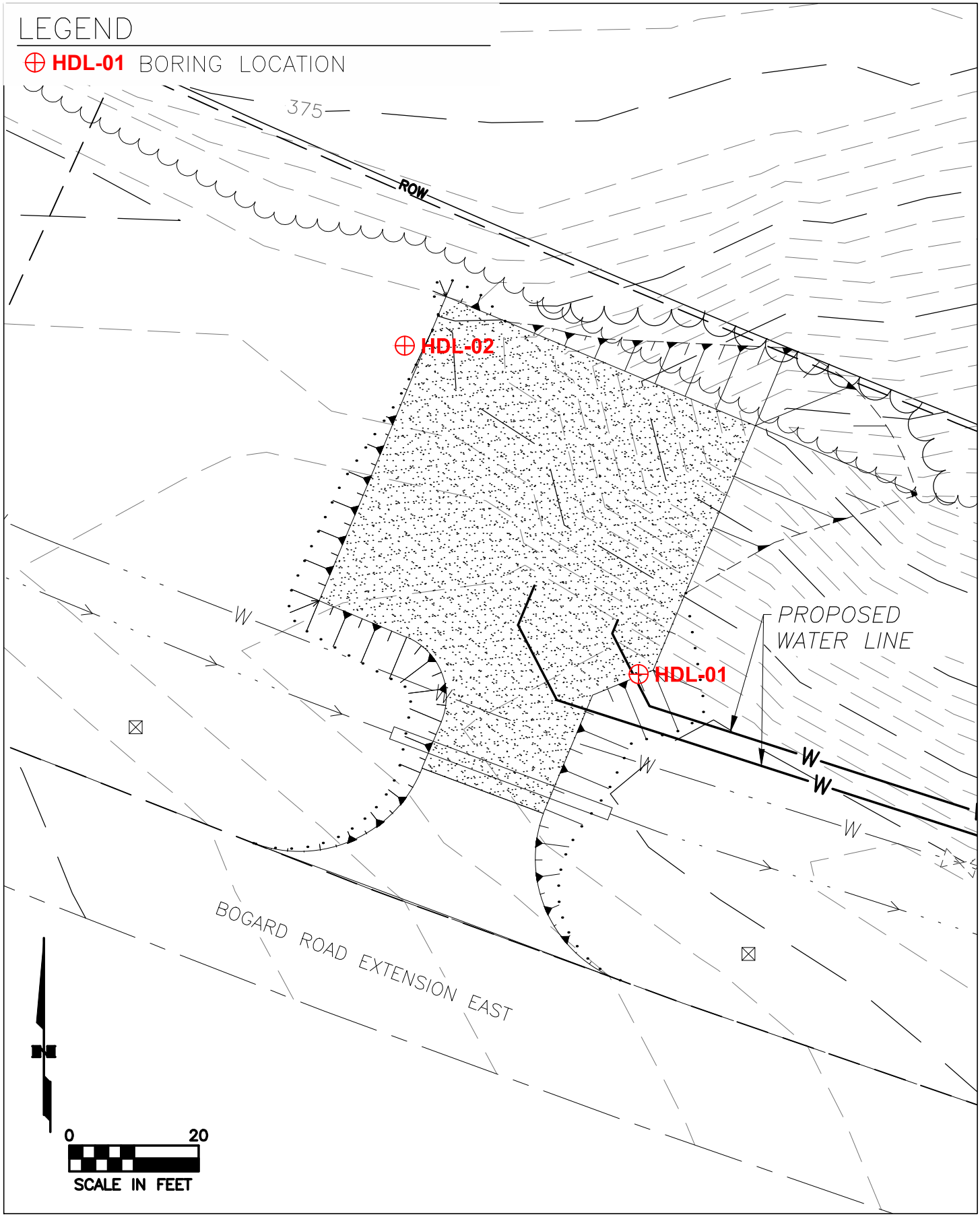
The soil borings were drilled by Geotek Alaska, Inc., of Anchorage, Alaska, working as a subcontractor to HDL. The borings were advanced using a truck mounted CME 75 drill rig with 3.25-inch inside diameter (I.D.) hollow stem augers and the soils were sampled using a 3.0-inch outside diameter (O.D.) split-spoon sampler. Split-spoon sampling was conducted in accordance with the Modified Penetration Test (MPT) Procedure. Split-spoons were advanced into the bottom of the boring with blows from a 340-pound hammer free-falling 30 inches onto the drill rods. The number of blows required to advance the sampler the bottom 12 inches of an 18-inch sample is termed the Penetration Resistance, designated as the "N-value", and was recorded for each sample depth. The values give a measure of the relative density (compactness) or consistency (stiffness) of unfrozen cohesionless and cohesive soils, respectively. Drilling and sampling was performed in general accordance with the procedures outlined in the Alaska Department of Transportation and Public Facilities (DOT&PF) "Alaska Geotechnical Procedures Manual". An experienced HDL engineering assistant was present during drilling to locate the borings, collect samples, log subsurface conditions, and observe groundwater depths where encountered.

Recovered soils were classified in the field in general accordance with ASTM International Standard (ASTM) D2488. Samples were collected, sealed in heavy plastic bags to retain moisture, and delivered to HDL's laboratory for further testing.

Based on the laboratory test results, soil descriptions were confirmed or modified according to the Unified Soil Classification System (USCS), as summarized on Figure A1. As appropriate, samples were given a frost design classification in accordance with a modified United States Army Corps of Engineers (USACE) system as presented as Figure A2, Frost Design Soil Classification. The boring logs are included in Appendix A.

5.0 LABORATORY TESTING

Laboratory testing of the soil samples was conducted at HDL's American Association of State Highway and Transportation Officials (AASHTO) Materials Reference Laboratory (AMRL) accredited and USACE validated laboratory. Select laboratory tests were performed on samples recovered from the borings to confirm and/or modify field classifications and evaluate the properties of the soil.



H:\jobs\16-033 Palmer Bogard Rd Booster Station (COP)\01 Geotechnical\CAD\Drawings\16033_00_FIG-2-BOREHOLE, 1=1, 05-11-17 at 10:23 by jkk
LAYOUT: G1.03
VIEW: G103_H_PDF, G103_H_X7700
XREF: 16033_00_X_BASE, 16033_00_X_ROW, 16033_00_X_SURVEY BASE, 16033_00_X01

CITY OF PALMER
PALMER, AK

Figure 2
BOREHOLE LOCATION MAP
BOGARD ROAD BOOSTER STATION
PALMER, AK

Eighteen (18) moisture content tests were performed in accordance with ASTM D2216. Four (4) P200 tests, which quantifies the amount of material finer than the #200 sieve, were performed in accordance with ASTM D1140. Two (2) grain size distribution tests were performed in accordance with ASTM D422. The results of the laboratory testing are depicted on the boring logs in Appendix A as Figures A3 and A4. The results of the the grain size distributions are depicted in Appendix A as Figure A5.

6.0 SUBSURFACE CONDITIONS

In general, granular material, consisting of gravel and cobbles with varying amounts of sand, was encountered below a layer of organics and silt and extended to depth. The subsurface conditions are further summarized below and detailed information can be found on the boring logs presented in Appendix A, as Figures A3 and A4.

6.1 Subsurface Soils

Organic topsoil was encountered at the ground surface in both borings and ranged from 2 inches to 4 inches thick. Silt was encountered below the organic surface layer in both borings. The observed thickness of the silt layer was approximately 2.7 feet in HDL-01 and 2.5 feet in HDL-02. The measured N-values ranged from 2 to 9, generally indicating very loose to loose soils. The measured moisture content of the silt ranged from 25.7% to 33.0%.

A layer of sand and silt was encountered beneath the silt layer in HDL-02. The observed thickness of the sand and silt layer was approximately 2.9 feet. The measured N-value was 11, generally indicating medium dense soils. The measured moisture content of the sand and silt layer was 14.0%. The fines content of the sand and silt layer was 26.8%, indicating moderate to highly frost susceptible (F3) material.

Granular material consisting primarily of gravel and cobbles with varying amounts sand and silt was encountered beneath the silt-rich layer in both borings. The granular material extended to depth in HDL-01 and was approximately 14.6 feet thick in HDL-02. The measured N-values ranged from 11 to 40, generally indicating medium dense to dense soils. The measured moisture contents of the granular material ranged from 1.0% to 8.1%. The fines contents of the granular material ranged from 3.8% to 9.5%, indicating non-frost susceptible (NFS) to low frost susceptible (F1) material.

Silt with gravel was encountered below the granular material in HDL-02 and extended to depth. The measured N-value was 42, generally indicating dense soils. The measured moisture content of the silt was 7.1%.

6.2 Groundwater

Groundwater was encountered in HDL-02 during drilling at depth of 30 feet bgs. Groundwater levels fluctuate depending on season, temperatures, and infiltration. Groundwater levels during construction may be higher or lower than those observed.

7.0 ENGINEERING ANALYSIS & RECOMMENDATIONS

Design of any structure's foundation must consider the bearing support capabilities of the supporting soils as well as the expected settlements and effects of seasonal frost action. A summary of the geotechnical considerations and recommendations are provided below.

7.1 Site Work

The following sections provide a summary of geotechnical considerations for the site development.

7.1.1 Site Preparation

Surface organics and topsoil should be stripped prior to construction. Stripped surface soils should not be utilized for Structural Fill, but may be used as topsoil in areas to be seeded.

Silt-rich materials encountered within the upper six (6) feet are expected to be moderately to highly frost susceptible (F3-F4) and seasonal movement due to frost action is expected. Some of the silt-rich material should be removed and replaced with non-frost susceptible (NFS) to low frost susceptible (F1) structural fill within the building footprint, driveway, and parking areas to limit seasonal frost movement.

The silt-rich materials should be removed and replaced to a minimum depth of eighteen (18) inches below the proposed building floor slab. The silt-rich materials should be removed and replaced to a minimum depth of eighteen (18) inches below the base of paved surfaces, driveways, and parking areas. The silt-rich materials should be removed and replaced to a minimum depth of twelve (12) inches below building foundations.

If soft or unstable soils or other deleterious materials are encountered during construction, the materials should be removed and replaced with compacted Structural Fill. We recommend that the exposed subgrade soils be proof-rolled to provide a level, firm, uniform surface prior to the placement of fill. An experienced geotechnical engineer should observe the exposed subgrade conditions and the compacted Structural Fill.

Silt-rich materials will be exposed in the subgrade during construction. Silt-rich materials will retain moisture if exposed to precipitation. When wet, these soils will lose strength and be more susceptible to frost action. In addition, the silt-rich materials will be difficult to moisture condition and compact. It is recommended that exposure of the subgrade be limited to maintain the integrity of the subgrade. The contractor should be prepared for challenges during construction if the subgrade soils get wet.

7.1.2 Structural Fill and Compaction

Structural Fill placed to construct the building pad, structural areas, driveway embankments, and pavement sections should be granular and consist of a relatively well graded mixture of clean sands and gravels to provide drainage and frost protection. Structural Fill placed within the building pad, parking area, and access driveway should consist of 18-inches of subbase meeting the COP Standard General Provisions requirements for Type II-A material. If greater than 18-inches of fill is needed, the Structural Fill may be underlain by Usable Excavation. The Usable

Excavation should consist of low frost susceptible (F1) sands and gravels meeting the COP Standard General Provisions requirements for Type III material. On-site organic- and silt-rich layers generally do not meet the requirements for non-frost susceptible (NFS) or low frost susceptible soils (F1). Gradation requirements for Structural Fill and Usable Excavation are detailed in Table 1, Fill Gradations.

Table 1 - Fill Gradations

SIEVE	Material	
	Type II-A	Type III
	% Passing	
3"	100	-
3/4"	50-100	-
No. 4	25-60	-
No. 10	15-50	-
No. 40	4-30	-
No. 200	2-6	10

Structural Fill and Usable Excavation should be placed in lifts not to exceed ten (10) to twelve (12) inches loose thickness, and compacted to a density of at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D1557) or vibratory table (ASTM D4253) as appropriate. During fill placement, we also recommend that large cobbles or boulders with dimensions in excess of 2/3 the lift thickness be removed.

The bottom of all footing excavations should be compacted to a density of at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D1557) or vibratory table (ASTM D4253) as appropriate.

7.1.3 Pavement Recommendations

Where the parking lot or driveway will be paved, the pavement section should consist of two (2) inches of hot mix asphalt (HMA) over four (4) inches of Leveling Course. The Leveling Course should be underlain by eighteen (18) inches of Structural Fill. The Leveling Course should meet the COP Standard General Provisions requirements for Leveling Course. Gradation requirements for Leveling Course materials are detailed in Table 2, Leveling Course Gradation.

Table 2 - Leveling Course Gradation

Leveling Course	
Sieve	% Passing
1"	100
3/4"	70-100
3/8"	50-80
No. 4	35-65
No. 8	20-50
No. 50	10-30
No. 200	3-8

The leveling course should be compacted to a density of at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D1557) or vibratory table (ASTM D4253) as appropriate.

7.1.4 Surfacing

The unpaved portions of the access driveway and gravel pad should have a minimum of 6-inches of Surface Course over the Structural Fill. The Surfacing Course should meet the Alaska Department of Transportation & Public Facilities Standard Specifications requirements for Aggregate Surface Course, Gradation E-1. Gradation requirements for Surface Course material are detailed in Table 3, Surface Course Gradation.

Table 3 - Surface Course Gradation

Aggregate Surface Course, Gradation E-1	
Sieve	% Passing
1"	100
3/4"	70-100
3/8"	50-85
No. 4	35-65
No. 8	20-50
No. 50	13-30
No. 200	8-15

The surface course should be compacted to a density of at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D1557) or vibratory table (ASTM D4253) as appropriate.

7.2 Utility Trenches

The proposed water line extension should be founded within granular Bedding Material with a minimum thickness of six (6) inches placed below the pipe. The Bedding Material should be carried up both sides for the full width of the trench, to a minimum of six (6) inches above the pipe crown. To avoid hard points at the pipe, any soil particles larger than three (3) inches

should be removed from backfill materials that will be placed within a one (1) foot proximity to the pipe. Four (4) inches of insulation should be installed over the bedding material. Useable excavation material should be used to backfill the trench to the bottom of the structural section.

Bedding Material should meet the COP Standard General Provisions requirements for Class "C" Bedding. Gradation requirements for bedding material are detailed in Table 4, Bedding Material Gradation.

Table 4 – Bedding Material Specifications

Class "C" Bedding	
Sieve	% Passing
2"	100
1/2"	40-100
No. 4	20-75
No. 10	12-60
No. 40	2-30
No. 200	0-6

The Bedding Material should be placed in maximum six (6) inch loose lifts, near the optimum moisture content and compacted to 90 percent of the maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D1557) or vibratory table (ASTM D4253) as appropriate.

7.3 Culvert Pipe

The proposed corrugated metal pipe (CMP) culvert should be founded within granular Bedding Material with a minimum thickness of four (4) inches placed below the pipe. This material should be carried up both sides for the full width of the trench, to the midway point of the pipe. Subbase meeting the COP Standard General Provisions requirements for Type II-A material should be placed from the top of the bedding material to the bottom of the structural section. To avoid hard points at the pipe, any soil particles larger than three (3) inches should be removed from backfill materials that will be placed within a one (1) foot proximity to the pipe.

7.4 Seismic Analysis

The site characterization criteria found in the 2015 International Building Code (Code) should be used for design. The seismic design criteria are found in Chapter 16, Section 1613 of the Code. The Code requires that the site characterization be determined by soil and rock parameters. Based on the subsurface conditions encountered, we recommend the site be considered Seismic Site Class "D". For the purpose of the seismic design, the site was classified as an essential facility, Occupancy Class IV. The maximum considered earthquake ground motion spectral response accelerations for short period and for one-second peaks were obtained utilizing the United States Geological Survey's (USGS's) Earthquake Hazards Program; results of which are summarized in Table 5, Seismic Design Criteria.

Table 5 - Seismic Design Criteria

IBC 2015 Seismic Design Criteria	Value
Spectral Response at Short Periods, S_S	1.572
Spectral Response at 1-Second Period, S_1	0.805
Site Class	D
Site Coefficient F_a	1.000
Site Coefficient F_v	1.500
Site Adjusted Spectral Response at Short Periods, S_{MS}	1.572
Site Adjusted Spectral Response at 1-second Periods, S_{M1}	1.208

7.5 Foundation Analyses

Design of any structure's foundation must consider the bearing support capabilities of the supporting soils, the effects of seasonal frost action, and the expected total and differential settlements. The foundation system must also consider the risk of failure and the cost of construction.

Based on conditions encountered, shallow continuous and/or spread footing foundations can be used to support the proposed improvements. Exterior, heated foundations should bear a minimum of 3.5 feet below finished exterior grade. Interior, heated foundations should bear a minimum of 1.5 feet below finished floor elevation. Exterior, unheated foundations should bear a minimum of 10 feet below finished exterior grade.

Strip footing foundations should be at least 16 inches wide and isolated column pads should be at least 24 inches wide to reduce the possibility of punching shear failure within foundation support material, regardless of calculated bearing pressure.

A minimum of twelve (12) inches of compacted Structural Fill meeting the COP Standard General Provisions requirements for Type II-A material or better should be placed below all foundations.

Foundations should be constructed immediately after subgrade preparation to protect the soil bearing surface. In addition, foundation excavations should be backfilled as soon as possible after foundation construction. Excavations along foundation walls should be filled such that the fill at the interior and exterior sides of the walls are at about the same height for lateral pressure considerations whenever possible.

7.5.1 Allowable Bearing Pressures

HDL assumes the proposed buildings will be constructed on Structural Fill overlying in-situ granular material. If the soils beneath the proposed foundations are consistent with those encountered during the subsurface evaluation and are prepared as recommended, a typical allowable soil bearing capacity of 4,000 pounds per square foot (psf) should be used for design of foundations. The above bearing value may be increased by one-third for seismic or wind loading conditions.

7.5.2 Settlement

The total settlements that will develop are dependent upon the actual loads that are applied, the dimensions of the foundations, the density of the supporting soil, and the care with which fills are placed and compacted. For shallow foundations designed as recommended above, we estimate that total settlements of about ¾-inch will occur and that differential settlements will be about one-half the total. Settlement is expected to develop elastically as the building is constructed.

7.6 Frost Susceptibility

Palmer is in a region of mild to moderate freeze and thaw cycles. Soils throughout the project consisted of non- to highly frost susceptible (NFS to F4). The foundations must be designed to protect the underlying soil from frost. Further detail about foundation depth and construction is discussed in the previous sections.

Following the recommendations above will result in partial frost protection of the driveway and parking area. Some seasonal movement due to frost action is expected within the driveway and parking area.

7.7 Drainage and Dewatering

Groundwater was encountered in HDL-02 at approximately 30-feet bgs. However, groundwater levels vary depending on time of year. Based on the observed groundwater depths, subdrains are not needed for shallow foundations. Dewatering is not anticipated to be necessary based on groundwater conditions encountered during drilling. The need for dewatering will depend on the time of year for construction and the depth of the trench. Heavy precipitation may cause soils to become saturated and less stable. Surface water should be directed away from the excavations.

To discourage water from ponding next to the building pad and reaching the foundations, the surface around exterior walls should be paved or covered with topsoil and the finished grade sloped to direct surface water away from the structure. Near surface soils should be compacted to reduce permeability.

7.8 Excavations and Shoring

It is assumed that temporary excavations will be needed to support the foundation construction. Shoring may be required if unstable soils are encountered. Additional loads from adjacent equipment, hydrostatic pressure, and structures must also be accounted for in the pressure distribution for shoring design.

HDL recommends that the trench side slopes, trench bottom conditions, and dewatering efforts be made the responsibility of the contractor as he is present on a day to day basis and can adjust his efforts to obtain the needed stability, trench conditions, and meet the applicable Alaska and Federal Occupational Safety and Health Administration (OSHA) safety regulations. Deviation from the OSHA stipulations requires the approval of a licensed Professional Geotechnical Engineer.

8.0 CLOSURE AND LIMITATIONS

The analysis and conclusions included in this report are based on site conditions as they exist in the borings observed by HDL. The analysis and conclusions assume that the exploratory borings are representative of the subsurface conditions throughout the site, that is, that the subsurface conditions everywhere are not significantly different from those disclosed in the borings. If, during construction, subsurface conditions are different from those encountered, advise us at once so we can review these conditions.

If substantial time has elapsed between submission of this report and the start of work at the site, or if conditions have changed because of natural causes or construction operations at or adjacent to the site, we recommend that this report be reviewed to determine the applicability of the conclusions considering the time lapse or changed conditions.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by merely taking soil samples or advancing borings. Such unexpected conditions frequently require additional expenditure to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

Prepared by:
HDL Engineering Consultants, LLC

Jeremy Dvorak, EIT
Engineering Assistant

Reviewed By:
HDL Engineering Consultants, LLC

Doug P. Simon, P.E.
Geotechnical Services Manager

AECL 861

STATE OF ALASKA
DOUGLAS P. SIMON
CE - 13943
REGIST
PROFESSIONAL ENGINEER

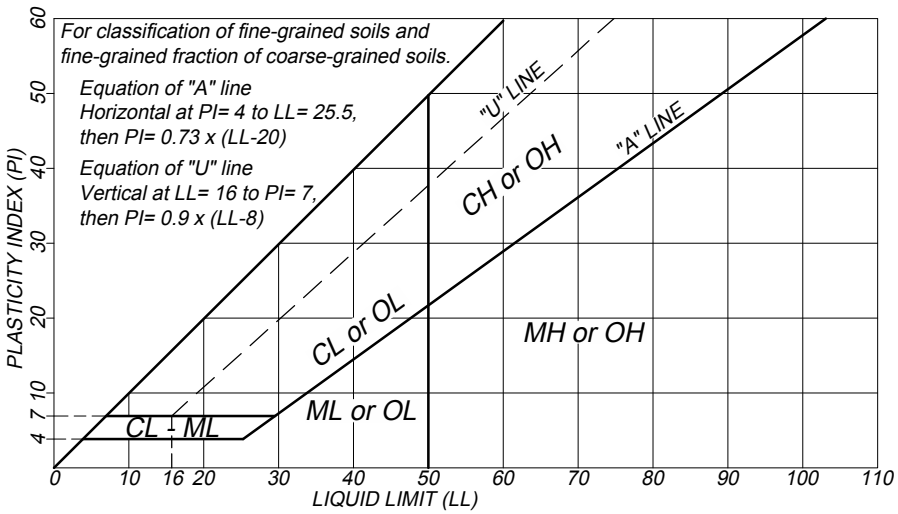
6/5/17

APPENDIX A

Figure A1	Unified Soil Classification System
Figure A2	Frost Design Soil Classification
Figures A3 - A4	Boring Logs
Figure A5	Grain Size Distribution Curves

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Names			Soil Classification Generalized Group Descriptions	
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS Less than 5% fines	GW	Well-graded Gravels
			GP	Poorly-graded Gravels
		GRAVELS with fines More than 12% fines	GM	Gravel & Silt Mixtures
			GC	Gravel & Clay Mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS Less than 5% fines	SW	Well-graded Sands
			SP	Poorly Graded Sands
		SANDS with FINES More than 12% fines	SM	Sand & Silt Mixtures
			SC	Sand & Clay Mixtures
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid limit 50% or less	INORGANIC	ML	Non-plastic & Low Plasticity Silts
			CL	Low-plasticity Clays
		ORGANIC	OL	Non-plastic and Low Plasticity Organic Clays
				Non-plastic and Low Plasticity Organic Silts
	SILTS AND CLAYS Liquid limit greater than 50%	INORGANIC	CH	High-plasticity Clays
			MH	High-plasticity Silts
		ORGANIC	OH	High plasticity Organic Clays High Plasticity Organic Silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat



H:\jobs\16-033 Palmer Bogard Rd Booster Station (COP)\01 Geotechnical\CAD\Drawings\16-033_00_FIGA1, 1=1, 05-11-17 at 10:42 by jkk
LAYOUT: Layout1

CITY OF PALMER
PALMER, AK

Figure A1
UNIFIED SOIL CLASSIFICATION SYSTEM
BOGARD ROAD BOOSTER STATION
PALMER, AK

FROST DESIGN SOIL CLASSIFICATION
(Modeled after U.S. Army Corps of Engineers Standards)

GROUP	KIND OF SOIL	P200	TYPICAL SOILS
NFS	Sand or Gravel	0 to 6	SW, SP GW, GP
F1	Gravelly Soils	6 to 10	GM, GW-GM, GP-GM
F2	Gravelly Soils Sands	10-20 6-15	GM, GW-GM, GP-GM SW, SP, SM, SW-SM, SP-SM
F3	Gravelly Soils Sands, except very fine silty sands Clays PI > 12	Over 20 Over 15	GM, GC SM, SC CL, CH CL, CH
F4	All Silts Very fine silty sands Clays, PI < 12 Varved clays and other fine-grained, banded sediments	Over 15	ML, MH SM CL, CL-ML CL and ML CL, ML, and SM; CL, CH, and ML; CL, CH, ML, and SM

P200 = percent passing the number 200 sieve

CITY OF PALMER
PALMER, AK

Figure A2
FROST DESIGN SOIL CLASSIFICATION
BOGARD ROAD BOOSTER STATION
PALMER, AK

LOG OF BORING

HOLE # HDL-01

PROJECT NUMBER : *16-033*
PROJECT : *Bogard Road Booster Station*
CLIENT : *City of Palmer*

Station / Location: *Near proposed water line*
Lat/Long:
Elevation:

Equipment Type: *CME 75*
Drilling Method: *Hollow-Stem Auger*
Field Crew: *Geotek AK*

Total Depth: *21.5 feet*
Date: *5/2/2017*
Geologist: *J. Dvorak*

Ground Water Data		
Depth in (ft.)		
Time		
Date		
Symbol		

Depth (Feet)	Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0									Organic Topsoil; (Did not retain) 0.0
1	SS	S-1	2, 3, 6			9			SILT; little gravel, fine to coarse; little sand, fine; little organics; brown, moist, loose 0.2 Moisture =25.7%
2									
3	SS	S-2	2, 8, 13			21			Well-graded GRAVEL, fine to coarse; little sand, fine to coarse; little silt; trace organics; brown to grey, moist to dry, medium dense 2.9 P200 =9.5%, Sa =28.2%, Gr =62.3%, Moisture =4.3%
4									
5	SS	S-3	6, 6, 5			11			Well-graded GRAVEL, fine to coarse; with cobbles; some sand, fine to coarse; trace to little silt; brown, dry, medium dense 5.0 Moisture =3.4% P200= 6.4%
6									
7									
8	SS	S-4	5, 10, 15			25			Moisture =1.0% P200= 2.7%; Fractured cobble in tip of spoon
9									
10	SS	S-5	6, 12, 13			25			COBBLES; with gravel, fine to coarse; little sand, fine to coarse; trace silt; grey, dry, medium dense 10.0 Moisture =1.0% Fractured cobbles in spoon
11									
12									
13	SS	S-6	9, 14, 11			25			Well-graded GRAVEL, fine to coarse; with cobbles; some sand, fine to coarse; trace silt; brown, dry, medium dense 12.5 Moisture =1.6% Did not recover cobbles
14									
15	SS	S-7	5, 13, 15			28			Well-graded GRAVEL, fine to coarse; with sand, fine to coarse; some cobbles; trace silt; greyish brown, dry, medium dense 15.0 Moisture =2.5% ~0.25-inch silt seam
16									
17									

☒ Auto Hammer ☐ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Figure A3

HDL ENGINEERING Consultants

LOG OF BORING

HOLE # HDL-01

PROJECT NUMBER : *16-033*
PROJECT : *Bogard Road Booster Station*
CLIENT : *City of Palmer*

Station / Location: *Near proposed water line*
Lat/Long:
Elevation:

Equipment Type: *CME 75*
Drilling Method: *Hollow-Stem Auger*
Field Crew: *Geotek AK*

Total Depth: *21.5 feet*
Date: *5/2/2017*
Geologist: *J. Dvorak*

Ground Water Data		
Depth in (ft.)		
Time		
Date		
Symbol		

Depth (Feet)	Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
17									Well-graded GRAVEL, fine to coarse; with sand, fine to coarse; some cobbles; trace silt; greyish brown, dry, medium dense (cont.) Drilling becomes easier
18									
19									
20	SS	S-8	4 7 11			18			Poorly-graded SAND, fine to medium; some silt; little to some gravel, fine; brown, dry, medium dense Moisture =8.1% — 20.0
21								BOH 21.5	21.5

Notes:
Soil descriptions may not match grain size distribution curves due to the presence of cobbles. Soil classifications based on observed conditions during drilling operations. No groundwater was observed during drilling operations.

☒ Auto Hammer ☐ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 2 of 2

A USCS LOG OF TEST HOLE 16-033 PALMER BOGARD RD BOOSTER STATION.GPJ HDL MODIFIED.GDT 6/2/17

Figure A3

LOG OF BORING

HOLE # HDL-02

PROJECT NUMBER : *16-033*
PROJECT : *Bogard Road Booster Station*
CLIENT : *City of Palmer*

Station / Location: *Near proposed booster station*
Lat/Long:
Elevation:

Equipment Type: *CME 75*
Drilling Method: *Hollow-Stem Auger*
Field Crew: *Geotek AK*

Total Depth: *31.5 feet*
Date: *5/2/2017*
Geologist: *J. Dvorak*

Ground Water Data		
Depth in (ft.)	30	
Time		
Date	5/2/17	
Symbol	▽	

Depth (Feet)	Sample Type	Number	Blow Count	Sample Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL	
0								Organic Topsoil; (Did not retain)	0.0
1	SS	S-1	3, 1, 1		2			SILT; little gravel, fine to coarse; little sand, fine to coarse; little organics; brown, moist, very loose Moisture =33.0%	0.3
2									
3	SS	S-2	3, 6, 5		11			Poorly-graded SAND, fine to coarse; some silt; little gravel, fine to coarse; trace organics; brown, moist, slight mottling, medium dense Moisture =14.0% P200= 26.8%	2.5
4									
5	SS	S-3	5, 8, 9		17			COBBLES; with sand, fine to coarse; some gravel, fine to coarse; trace to little silt; brown, dry, medium dense Moisture =2.0% P200= 4.4%	5.4
6									
7									
8	SS	S-4	15, 8, 11		19			COBBLES; with gravel, fine to coarse; some sand, fine to coarse; trace silt; greyish brown, dry, medium dense to dense P200 =3.8%, Sa =29.5%, Gr =65.9%, Moisture =2.2% Fractured cobbles in spoon	7.5
9									
10	SS	S-5	5, 13, 27		40			Moisture =1.9% Fractured cobbles in spoon	
11									
12									
13	SS	S-6	12, 16, 15		31			Moisture =1.5% Fractured cobbles in spoon	
14									
15	SS	S-7	8, 14, 16		30			Moisture =1.9% Fractured cobbles in spoon	
16									
17									

☒ Auto Hammer ☐ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Figure A4

HDL ENGINEERING Consultants

LOG OF BORING

HOLE # HDL-02

PROJECT NUMBER : *16-033*
PROJECT : *Bogard Road Booster Station*
CLIENT : *City of Palmer*

Station / Location: *Near proposed booster station*
Lat/Long:
Elevation:

Equipment Type: *CME 75*
Drilling Method: *Hollow-Stem Auger*
Field Crew: *Geotek AK*

Total Depth: *31.5 feet*
Date: *5/2/2017*
Geologist: *J. Dvorak*

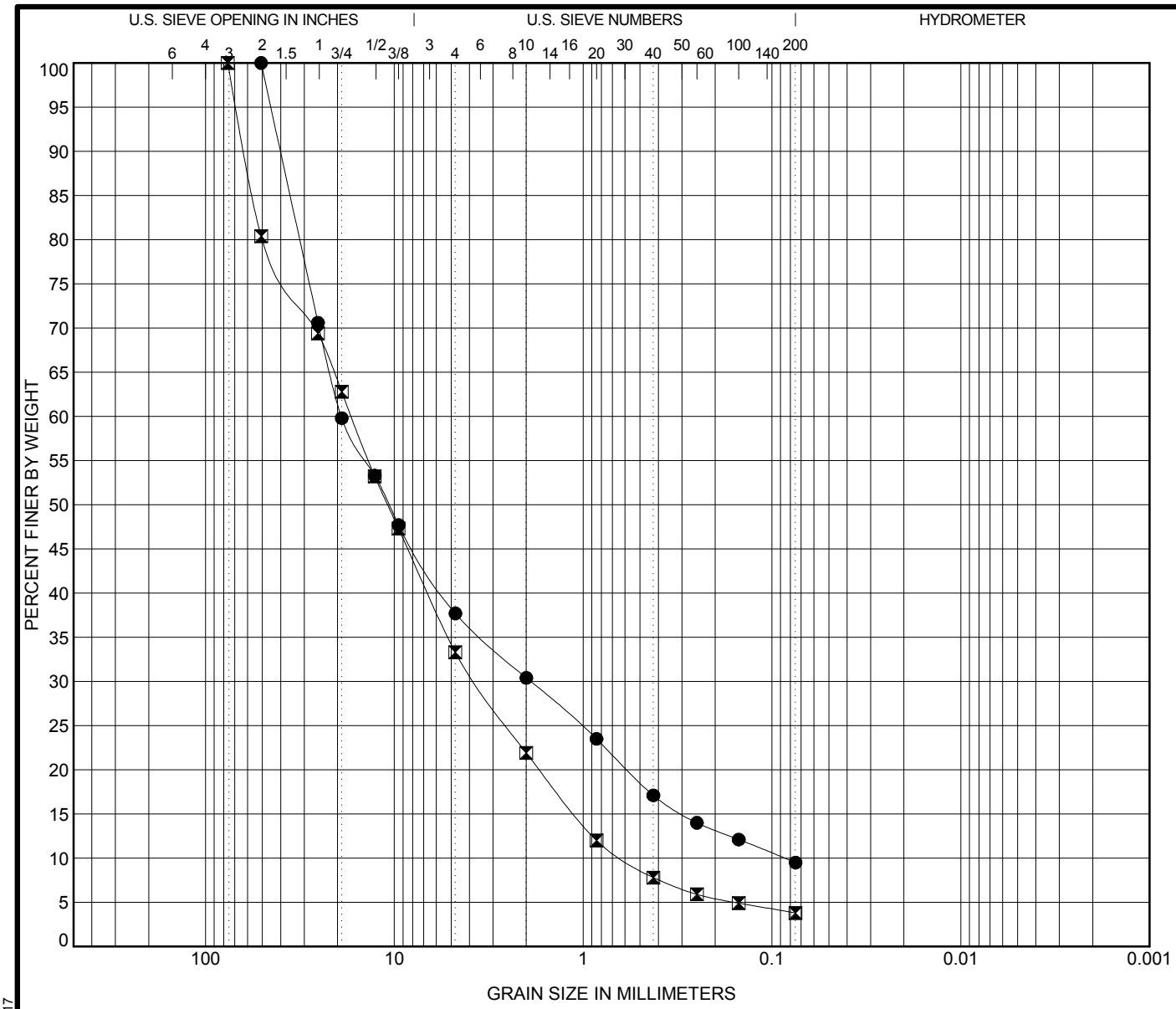
Ground Water Data		
Depth in (ft.)	30	
Time		
Date	5/2/17	
Symbol	▽	

Depth (Feet)	Sample Type	Number	Blow Count	Sample	Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
17									COBBLES; with gravel, fine to coarse; some sand, fine to coarse; trace silt; greyish brown, dry, medium dense to dense (cont.)
18									
19									
20	SS	S-8	15			38			Moisture =1.6% Fractured cobbles in spoon
			20						
21			18						
22									
23									
24									
25	SS	S-9	14			36			Moisture =1.7% Fractured cobbles in spoon
			14						
26			22						
27									
28									
29									
30 ▽	SS	S-10	6			42			SILT; with gravel, fine to coarse; some cobbles; little to some sand; grey, wet to moist, dense Moisture =7.1% — 30.0
			15						
31			27						
								BOH 31.5	31.5

Notes:
Soil descriptions may not match grain size distribution curves due to the presence of cobbles.
Soil classifications based on observed conditions during drilling operations.

☒ Auto Hammer ☐ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Figure A4



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**HDL-01**	**DEPTH 2.9**					**2.21**	**222.91**
⧗	**HDL-02**	**DEPTH 7.5**	**WELL-GRADED GRAVEL with SAND(GW)**				**1.32**	**27.65**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**HDL-01**	**DEPTH 2.9**	**50.8**	**19.102**	**1.903**	**0.086**	**62.3**	**28.2**	**9.5**	
⧗	**HDL-02**	**DEPTH 7.5**	**76.2**	**16.894**	**3.698**	**0.611**	**65.9**	**29.5**	**3.8**	

HDL ENGINEERING Consultants
3335 Arctic Blvd Ste 100
Anchorage, AK 99503
Telephone: 907-564-2120
Fax: 907-564-2122

GRAIN SIZE DISTRIBUTION

Project: Bogard Road Booster Station

Client: City of Palmer

Project Number: 16-033

Figure A5