



47A York Street
Portland, ME 04101
(207) 553-7753

BUREAU OF REAL ESTATE MANAGEMENT (BREM)

EAST CAMPUS STEAM PLANT UPGRADE at Augusta, Maine

AdvantageME CT No. 2018081600000000563

Specifications – Issued for Bid May 22, 2019

Prepared for:

Bureau of Real Estate Management
State of Maine, DAFS
111 Sewall Street
77 SHS. 4th Floor

Division	Section Title	Pages
----------	---------------	-------

SPECIFICATIONS GROUP

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

001113	NOTICE TO CONTRACTORS	2
002113	INSTRUCTIONS TO BIDDERS	3
004113	CONTRACTOR BID FORM	3
004313	CONTRACTOR BID BOND	2
005213	CONTRACT AGREEMENT	4
006113.13	CONTRACTOR PERFORMANCE BOND	2
006113.16	CONTRACTOR PAYMENT BOND	2
006363	CONSTRUCTION CONTRACT – BREM CHANGE ORDER TABLE A AND TABLE B	1
006363.1	CONSTRUCTION CONTRACT – BREM CHANGE ORDER TABLE C LIST OF ITEMS	1
006363.2	CONSTRUCTION CONTRACT – BREM CHANGE ORDER TABLE D DETAILS	1
007100	DEFINITIONS	5
007213	GENERAL CONDITIONS	23
007346	WAGE DETERMINATION SCHEDULE	2

Facility Services Subgroup

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT	3
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT	10
230719	HVAC PIPING INSULATION	8
231113	FACILITY FUEL-OIL PIPING	11
231123	FACILITY NATURAL-GAS PIPING	13
231126	FACILITY LIQUEFIED-PETROLEUM GAS PIPING	14
231213	FACILITY FUEL-OIL PUMPS	8
232213	STEAM AND CONDENSATE HEATING PIPING	8
232216	STEAM AND CONDENSATE HEATING SPECIALTIES	6
232223	STEAM CONDENSATE PUMPS	5
235100	BREECHINGS, CHIMNEYS, AND STACKS	2
235239	FIRE-TUBE BOILERS	24
235313	BOILER FEEDWATER PUMPS	6

DIVISION 26 - ELECTRICAL

260500	COMMON WORK RESULTS FOR ELECTRICAL	3
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES	4
260533	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS	5
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS	5

BUREAU OF REAL ESTATE MANAGEMENT
EAST CAMPUS STEAM PLANT REPLACEMENT
ISSUED FOR BID

MAY 22, 2019

262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS	6
262923	VARIABLE FREQUENCY MOTOR CONTROLLERS	8

END OF TABLE OF CONTENTS

00 11 13
Notice to Contractors

East Campus Steam Plant Upgrade

This project includes phased removal and replacement of three (3) steam boilers in the Mechanical Building on the East Campus. The Contractor will be required to complete improvements to the steam and condensate systems prior to the start of the heating season October 1, 2019. Following the improvements that must be performed while the steam system is down, two of the existing three boilers will be demolished. Existing Boiler No. 1 will remain operational until new Boiler No. 2 and No. 3 are installed and operational. At that time Boiler No.1 will be demolished and new Boliler 1 will be installed.

The cost of the work is approximately \$ 1,180,000. The work to be performed under this contract shall be completed on or before the Final Completion date of *18 December 2019*.

1. Sealed Contractor bids, in envelopes plainly marked "Bid for *East Campus Steam Plant*" and addressed to:
Jill Instasi
Bureau of Real Estate Management
111 Sewall Street, Cross State Office Building, 4th Floor
77 State House Station
Augusta, Maine 04333-0077
will be opened and read aloud at *the address shown above* at **2:00 p.m.** on **July 31, 2019**. Any bid submitted after the noted time will not be considered a valid bid and will remain unopened.
2. The bid shall be submitted on the Contractor Bid Form (section 00 41 13) provided in the Bid Documents. The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.
3. Bid security *is required* on this project.
If noted above as required, the Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with the completed bid form submitted to the Owner. The Bid Bond form is available on the BREM website.
4. Performance and Payment Bonds *are required* on this project.
If noted above as required, the selected Contractor shall furnish a 100% contract Performance Bond (section 00 61 13.13) and a 100% contract Payment Bond (section 00 61 13.16) in the contract amount to cover the execution of the Work. Bond forms are available on the BREM website.
5. Filed Sub-bids *are not required* on this project.
6. There *are* Pre-qualified General Contractors on this project.
If Pre-qualified General Contractors are identified for this project, the name of each company, with their city and state, are listed below.
7. An on-site pre-bid conference *will* be conducted for this project.
If a pre-bid conference is scheduled, it is *mandatory* for General Contractors and optional for Subcontractors and suppliers. Contractors who arrive late or leave early for a mandatory meeting may be prohibited from participating in this meeting and bidding. *July 16, 2019 at 10:00AM, at 5 Chimney Loop, Augusta East Campus.*

00 11 13
Notice to Contractors

8. Property Insurance for this construction contract, described in the Insurance Requirements section of the General Conditions of the contract, shall be Renovation or addition insured by Owner.
9. Bid Documents - full sets only - will be available on or about *insert date of availability* and may be obtained type "*at no cost*" or "*at a cost of \$x*" from:
Insert name of company
insert address
insert city, state, zip code
insert phone number and e-mail address
10. Bid Documents may be examined at:
- | | |
|--|--|
| <i>AGC Maine</i> | <i>Construction Summary</i> |
| <i>188 Whitten Road</i> | <i>734 Chestnut Street</i> |
| <i>Augusta, ME 04332</i> | <i>Manchester, NH 03104</i> |
| <i>Phone 207-622-4741 Fax 207-622-1625</i> | <i>Phone 603-627-8856 Fax 603-627-4524</i> |

00 21 13
Instructions to Bidders

1. Bidder Requirements

- 1.1 A bidder is a Contractor who is qualified, or has been specifically pre-qualified by the Bureau of Real Estate Management, to bid on the proposed project described in the Bid Documents.
- 1.2 Contractors and Subcontractors bidding on projects that utilize Filed Sub-bids shall follow the requirements outlined in these Bid Documents for such projects. See Section 00 22 13 for additional information.
- 1.3 Contractors and Subcontractors are not eligible to bid on the project when their access to project design documents prior to the bid period distribution of documents creates an unfair bidding advantage. Prohibited access includes consultation with the Owner or with design professionals engaged by the Owner regarding cost estimating, constructability review, or project scheduling. This prohibition to bid applies to open, competitive bidding or pre-qualified contractor bidding or Filed Sub-bidding. The Bureau may require additional information to determine if the activities of a Contractor constitute an unfair bidding advantage.
- 1.4 Each bidder is responsible for becoming thoroughly familiar with the Bid Documents prior to submitting a bid. The failure of a bidder to review evident site conditions, to attend available pre-bid conferences, or to receive, examine, or act on addenda to the Bid Documents shall not relieve that bidder from any obligation with respect to their bid or the execution of the work as a Contractor.
- 1.5 Prior to the award of the contract, General Contractor bidders or Filed Sub-bidders may be required to provide documented evidence to the Owner or the Bureau showing compliance with the provisions of this section, their business experience, financial capability, or performance on previous projects.
- 1.6 The selected General Contractor bidder will be required to provide proof of insurance before a contract can be executed.
- 1.7 Contracts developed from this bid shall not be assigned, sublet or transferred without the written consent of the Owner.
- 1.8 By submitting a bid the Contractor attests that it has not been declared ineligible to bid on State of Maine projects. The Director of the Bureau of Real Estate Management may disallow award of this contract to any Contractor if there is evidence that the Contractor or any of its Subcontractors, through their own fault, have been terminated, suspended for cause, debarred from bidding, agreed to refrain from bidding as part of a settlement, have defaulted on a contract, or had a contract completed by another party.
- 1.9 The Contractor attests that it is not presently indicted for or otherwise criminally or civilly charged by a Federal, State or local government entity with commission of any of the following offenses and has not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction, or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

00 21 13
Instructions to Bidders

- 1.10 The Contractor shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs or State of Maine projects.
2. Authority of Owner
- 2.1 The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.
- 2.2 Subject to the Owner's stated right to accept or reject any or all bids, the Contractor shall be selected on the basis of the lowest sum of an acceptable Base Bid plus any Alternate Bids the Owner elects to include. An acceptable bid is one from a responsive and responsible bidder.
3. Submitting Bids and Bid Requirements
- 3.1 Each bid shall be submitted on the forms provided in the Bid Documents.
- 3.2 Each bid shall be valid for a period of thirty calendar days following the Project bid opening date and time.
- 3.3 A bid that contains an escalation clause is considered invalid.
- 3.4 Bidders shall include a Bid Bond or other approved bid security with the bid form submitted to the Owner when the bid form indicates such bid security is required. The bond value shall be 5% of the bid amount. The form of bond is shown in section 00 43 13.
- 3.5 Bidders shall include the cost of Performance and Payment Bonds in the bid amount if the bid amount will result in a construction contract value over \$125,000, inclusive of alternate bids that may be awarded in the contract. Pursuant to 14 M.R.S.A., Section 871, Public Works Contractors' Surety Bond Law of 1971, subsection 3, the selected Contractor is required to provide these bonds before a contract can be executed. The form of bonds are shown in section 00 61 13.13 and 00 61 13.16.
- 3.6 Bidders may modify bids in writing prior to the bid closing time. Such written amendments shall not disclose the amount of the initial bid. If so disclosed, the entire bid is considered invalid.
- 3.7 Bidders shall acknowledge on the bid form all Addenda issued in a timely manner. The Consultant shall not issue Addenda affecting the content of the bid less than 72 hours prior to the bid closing time. Addenda shall be issued to all companies who are registered holders of Bid Documents.
- 3.8 A bid may be withdrawn without penalty if a written request by the bidder is presented to the Owner prior to the bid closing time. Such written withdrawal requests are subject to verification as required by the Bureau. After the bid closing time, such written withdrawal requests may be allowed in consideration of the bid bond or, without utilizing a bid bond, if the Contractor provides documented evidence to the satisfaction of the Bureau that factual errors had been made on the bid form.

00 21 13
Instructions to Bidders

- 3.9 In the event State of Maine Offices unexpectedly close on the published date of a public bid opening in the location of that bid opening, prior to the time of the scheduled deadline, the new deadline for the public bid opening will be the following business day at the originally scheduled hour of the day, at the original location. Official closings are posted on the State of Maine government website.
- 3.10 The Owner may require, in a Notice of Intent to Award letter to the apparent low bidder, a Schedule of Values, Project Schedule, and List of Subcontractors and Suppliers as a demonstration of capability of the Bidder and as a condition of award.
- 3.11 Projects which require a State of Maine wage determination will include that schedule as part of the Bid Documents. See section 00 73 46, if such rates are required.
- 3.12 Projects which require compliance with the Davis-Bacon Act are subject to the regulations contained the Code for Federal Regulations and the federal wage determination which is made a part of the Bid Documents. See section 00 73 46, if such rates are required.
- 3.13 The Owner is exempt from the payment of Maine State sales and use taxes as provided in 36 M.R.S. §1760 (1). The Contractor and Subcontractors shall not include taxes on exempt items in the construction contract.

00 41 13
Contractor Bid Form

insert project name

To: *insert name of person receiving bids*
Bureau of Real Estate Management
111 Sewall Street, Cross State Office Building, 4th Floor
77 State House Station
Augusta, Maine 04333-0077

The undersigned, or *Bidder*, having carefully examined the form of contract, general conditions, specifications and drawings dated *insert date of documents*, prepared by *insert name of Consultant* for *insert project name*, as well as the premises and conditions relating to the work, proposes to furnish all labor, equipment and materials necessary for and reasonably incidental to the construction and completion of this project for the **Base Bid** amount of:

\$ _____ .00

1. Allowances *<Bid Administrator to select...>* on this project.
<Bid Administrator to select...>
insert brief name of Allowance \$ *insert dollar amount of Allowance*

2. Alternate Bids *<Bid Administrator to select...>* on this project.
<Bid Administrator to select...>
Any dollar amount line below that is left blank by the Bidder shall be read as a bid of **\$0.00**.

1 *insert title of Alternate or "not used"* \$ _____ .00

2 *insert title of Alternate or "not used"* \$ _____ .00

3 *insert title of Alternate or "not used"* \$ _____ .00

4 *insert title of Alternate or "not used"* \$ _____ .00

5 *insert title of Alternate or "not used"* \$ _____ .00

**00 41 13
Contractor Bid Form**

3. The Bidder acknowledges receipt of the following addenda to the specifications and drawings:

Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____

4. Bid security <*Bid Administrator to select...*> on this project.
If noted above as required, the Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with this completed bid form submitted to the Owner.
5. Filed Sub-bids <*Bid Administrator to select...*> on this project.

**00 41 13
Contractor Bid Form**

insert project name

- 6. The Bidder agrees, if the Owner offers to award the contract, to provide any and all bonds and certificates of insurance, as well as Schedule of Values, Project Schedule, and List of Subcontractors and Suppliers if required by the Owner, and to sign the designated Construction Contract within twelve calendar days after the date of notification of such acceptance, except if the twelfth day falls on a State of Maine government holiday or other closure day, or a Saturday, or a Sunday, in which case the aforementioned documents must be received before 12:00 noon on the first available business day following the holiday, other closure day, Saturday, or Sunday.

As a guarantee thereof, the Bidder submits, together with this bid, a bid bond or other acceptable instrument as and if required by the Bid Documents.

- 7. This bid is hereby submitted by:

Signature: _____

Printed name and title: _____

Company name: _____

Mailing address: _____

City, state, zip code: _____

Phone number: _____

Email address: _____

State of incorporation, if a corporation: _____

List of all partners, if a partnership: _____

**00 43 13
Contractor Bid Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of five percent of the bid amount, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns, signed this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the first specified bid due date, or subsequent bid due date revised by addendum.

The condition of the above obligation is such that whereas the principal has submitted to the Owner, or State of Maine, to a certain bid, attached hereto and hereby made a part hereof, to enter into a contract in writing, for the construction of insert name of project as designated in the contract documents

Now therefore:

If said bid shall be rejected, or, in the alternate,

If said bid shall be accepted and the principal shall execute and deliver a contract in the form of contract attached hereto, properly completed in accordance with said bid, and shall furnish a bond for the faithful performance of said contract, and for the payment of all persons performing labor or furnishing material in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid, then this obligation shall be void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time within which the Obligee may accept such bid and said Surety does hereby waive notice of any such extension.

**00 43 13
Contractor Bid Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the bid due date.

Contractor

(Signature)

insert name and title

insert company name

*insert address
insert city state zip code*

Surety

(Signature)

insert name and title

insert company name

*insert address
insert city state zip code*

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

**State of Maine
CONSTRUCTION CONTRACT**

Large Construction Project

(Contract value \$50,000 or greater. Contract includes Project Manual, Specifications and Drawings)

Agreement entered into by and between the State of Maine through the **insert contracting entity name** hereinafter called the **Owner** and **insert Contractor company name** hereinafter called the **Contractor**.

BREM Project No.: **insert number assigned by BREM (not the PIP number)**

Other Project No.: _____

For the following Project: **title of project shown on documents** at **facility or campus name, municipality**, Maine.

The Specifications and the Drawings have been prepared by **firm name**, acting as Professional-of-Record and named in the documents as the Consultant Architect or Engineer.

The *Owner* and *Contractor* agree as follows:

ARTICLE 1 COMPENSATION AND PAYMENTS

1.1 The Owner shall pay the Contractor to furnish all labor, equipment, materials and incidentals necessary for the construction of the Work described in the Specifications and shown on the Drawings the Contract Amount as shown below.

Base Bid	<u>\$0.00</u>
<u><i>Alternate Bid number and name or "no Alternates"</i></u>	<u>\$0.00</u>
<u><i>Alternate Bid number and name or "no Alternates"</i></u>	<u>\$0.00</u>
<u><i>Alternate Bid number and name or "no Alternates"</i></u>	<u>\$0.00</u>
<u><i>Alternate Bid number and name or "no Alternates"</i></u>	<u>\$0.00</u>
<u><i>Alternate Bid number and name or "no Alternates"</i></u>	<u>\$0.00</u>
Total Contract Amount	<u>\$0.00</u>

1.2 The Contractor’s requisition shall contain sufficient detail and supporting information for the Owner to evaluate and support the payment requested.

1.2.1 Payments are due and payable twenty-five working days from the date of receipt of a Contractor requisition which is approved by the Owner.

1.2.2 Provisions for late payments will be governed by 5 M.R.S. Chapter 144, *Payment of Invoices Received from Business Concerns*, and interest shall be calculated at 1% per month.

ARTICLE 2 TIME OF COMPLETION

2.1 The Work of this Contract shall be completed on or before the Final Completion date of **31 December 2020**.

The following abbreviated definitions are for reference only, see Section 00 71 00 *Definitions* for actual definitions.
Substantial Completion: date of first beneficial use by the Owner.
Final Completion: the Contractor's final completion deadline.
Contract Expiration: the Owner's deadline for management of contract accounts.

ARTICLE 3 INELIGIBLE BIDDER

3.1 By signing this contract the Contractor attests that it has not been declared ineligible to bid on State of Maine projects. The Bureau of Real Estate Management may disallow award of this contract to any Contractor if there is evidence that the Contractor or any of its Subcontractors, through their own fault, have been terminated, suspended for cause, debarred from bidding, agreed to refrain from bidding as part of a settlement, have defaulted on a contract, or had a contract completed by another party.

3.2 By signing this contract the Contractor attests that it is not presently indicted for or otherwise criminally or civilly charged by a Federal, State or local government entity with commission of any of the following offenses and has not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction, or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

3.3 The Contractor shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs or State of Maine projects.

ARTICLE 4 CONTRACTOR'S RESPONSIBILITIES

4.1 On this project, the Contractor ***shall*** furnish the Owner the appropriate contract bonds in the amount of 100% of the Contract Sum. Contract bonds are mandated if the Contract Sum exceeds \$125,000, or if bonds are specifically required by the Contract Documents.

4.2 Property Insurance for this construction contract, described in the Insurance Requirements section of the General Conditions of the contract, shall be ***Non-standard project insured by Contractor.***

4.3 The Contractor shall comply with all laws, codes and regulations applicable to the Work.

4.4 The Contractor shall acquire all permits and third-party approvals applicable to the Work not specifically identified as provided by the Owner. Costs for Contractor-provided permits and third-party approvals shall be included in the Contract Sum identified in Section 1.1 above.

4.5 The Contractor shall remain an independent agent for the duration of this Contract, shall not become an employee of the State of Maine, and shall assure that no State employee will be compensated by, or otherwise benefit from, this Contract.

4.6 The Contractor shall be responsible for any design cost, construction cost, or other cost incurred on the Project to the extent caused by the negligent acts, errors or omissions of the Contractor or their Subcontractors in the performance of Work under this Contract.

ARTICLE 5 OWNER'S RESPONSIBILITIES

5.1 The Owner shall provide full information about the objectives, schedule, constraints and existing conditions of the project. The Owner has established a budget with reasonable contingencies that meets the project requirements.

5.2 By signing this contract, the Owner attests that all State of Maine procurement requirements for this contract have been met, including the solicitation of competitive bids.

ARTICLE 6 INSTRUMENTS OF SERVICE

6.1 The Contractor's use of the drawings, specifications and other documents known as the Consultant's Instruments of Service is limited to the execution of the Contractor's scope of work of this project unless the Contractor receives the written consent of the Owner and Consultant for use elsewhere.

ARTICLE 7 MISCELLANEOUS PROVISIONS

7.1 This Contract shall be governed by the laws of the State of Maine.

7.2 The Owner and Contractor, respectively, bind themselves, their partners, successors, assigns and legal representatives to this Contract. Neither party to this Contract shall assign the Contract as a whole without written consent of the other party, which consent the Owner may withhold without cause.

7.3 Notwithstanding any other provision of this Agreement, if the Owner does not receive sufficient funds to fund this Agreement or funds are de-appropriated, or if the Owner does not receive legal authority from the Maine State Legislature or Maine Courts to expend funds intended for this Agreement, then the Owner is not obligated to make payment under this Agreement; provided, however, the Owner shall be obligated to pay for services satisfactorily performed prior to any such non-appropriation in accordance with the termination provisions of this agreement. The Owner shall timely notify the Consultant of any non-appropriation and the effective date of the non-appropriation.

ARTICLE 8 CONTRACT DOCUMENTS

8.1 The General Conditions of the contract, instructions to bidders, bid form, Special Provisions, the written specifications and the drawings, and any Addenda, together with this agreement, form the contract. Each element is as fully a part of the Contract as if hereto attached or herein repeated.

8.2 Specifications: **indicate date of issuance of project manual**

8.3 Drawings: **note each sheet number and title**

8.4 Addenda: **note each addenda number and date, or "none"**

BREM Project No.: _____

The Agreement is effective as of the date last executed by the parties.

OWNER

CONTRACTOR

(Signature) (Date)
name and title

name of contracting entity

(Signature) (Date)
name and title

name of contractor company

(Indicate names of the review and approval individuals appropriate to the approval authority.)

<i>select proper approval authority</i>			
Reviewed by:		Approved by:	
_____ <i>(Signature)</i>	_____ <i>(Date)</i>	_____ <i>(Signature)</i>	_____ <i>(Date)</i>
<i>insert name</i>		<i>Joseph H. Ostwald</i>	
<i>Project Manager/ Contract Administrator</i>		<i>Director, Planning, Design & Construction</i>	

**00 61 13.13
Contractor Performance Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly and faithfully perform the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

**00 61 13.13
Contractor Performance Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

Contractor

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

Surety

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

**00 61 13.16
Contractor Payment Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the use and benefit of claimants, defined as an entity having a contract with the principal or with a subcontractor of the principal for labor, materials, or both labor and materials, used or reasonably required for use in the performance of the contract, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly satisfy all claims and demands incurred for all labor and materials, used or required by the principal in connection with the work described in the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, and shall fully reimburse the obligee for all outlay and expense with said obligee may incur in making good any default of said principal, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

**00 61 13.16
Contractor Payment Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

Contractor

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

Surety

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

State of Maine
CONSTRUCTION CONTRACT
Change Order

Project name
 location / school / campus

C. O. Number: **1**

Issue Date: **31-Jan-2020**

Contractor Company name
 address
 city state zip code

BREM Project No.:

Other Project No.:

Table A

Show Deduct as a negative number, e.g.: "-\$700".

	Add	Deduct	Total
Net Amount of this Change Order	\$0	\$0	
Amount of Previous Change Orders	\$0	\$0	
Net of Change Orders to Date	\$0	\$0	\$0
Original Contract Amount			\$0
Revised Contract Amount			\$0

Table B

Show Deduct as a negative number, e.g.: "-14".

	Add	Deduct	Total
Net Calendar Days Adjusted by this Change Order	0	0	
Calendar Days Adjusted by Previous Change Orders	0	0	
Net of Change Orders to Date	0	0	0
Original Contract Final Completion Date			31-Dec-2020
Revised Contract Final Completion Date*			31-Dec-2020

Consultant (Architect or Engineer)

Type firm name here
 Type person's name, title here

 signature date

Contractor

Type company name here
 Type person's name, title here

 signature date

Owner

Type contracting entity name here
 Type person's name, title here

 signature date

Owner's Rep / other - clear if not used

Type entity name here
 Type person's name, title here

 signature date

Bureau of Real Estate Management

-
 Type person's name, title here

 signature date

Attach list of Change Order items (Table C) and all supporting documentation.

For reference only, see Section 00 71 00 Definitions for full definitions:

Substantial Completion Date: date of first beneficial use by Owner.

*Contract Final Completion Date: Contractor's final completion deadline.

Contract Expiration Date: the Owner's deadline for management of contract accounts.

State of Maine
CONSTRUCTION CONTRACT

Change Order - List of Items

Project name
Contractor Company name

C. O. Number: 1

Table C

CO Item No.	Item name	Reason Code	Calendar Days	Cost
1	Insert brief name of CO item here		0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
			0	\$0
Totals			0	\$0

- Reason Code
- EO Error or omission of Consultant
 - UC Unforeseen job site condition
 - OC Owner-generated change
 - RC Regulatory authority-generated change
 - CC Contractor-generated change

Attach this sheet to the BREM Change Order Table A (cost) and Table B (time) summaries and signature sheet, and the BREM Change Order Table D (detailed data) sheet, and other supporting documentation.

Use multiples of this Table C sheet, if necessary, with a subtotal on each sheet, and the sum of subtotals of each sheet equal to the totals on Table A and Table B.

State of Maine
CONSTRUCTION CONTRACT

Change Order - Details

Project name
Contractor company name

C. O. Number:

TABLE D

ASI No.	RFI No.	CR No.	CP No.	CO Item No.
Item name				
Description of Work				
Reason or Necessity of Work				
Cost Breakdown	Subcontractor base cost	Subcontractor Markup ($\leq 20\%$)	Contractor base cost	Contractor Markup ($\leq 10\%$ or $\leq 20\%$)
	\$0	\$0	\$0	\$0
Reason Code	CC	Total Cost		\$0
Compensation	lump sum	Calendar Days		0
Initiated by	Consultant	Supporting documentation		is attached

Reason Code

EO Error or omission of Consultant
 UC Unforeseen job site condition
 OC Owner-generated change
 RC Regulatory authority-generated change
 CC Contractor-generated change

- Use one Table D sheet for each Change Order item.
- Use Table D sheets with the BREM Change Order Table A (cost) and Table B (time) summaries and signature sheet, and the BREM Change Order Table C (list of items) sheet.

signature

date

Consultant (A/E)

Contractor

Owner

Other

**Bureau of Real Estate
Management**

19 March 2019

00 71 00
Definitions

1. Definitions

- 1.1 *Addendum*: A document issued by the Consultant that amends the Bid Documents. Addenda shall not be issued less than seventy-two hours prior to the specified bid opening time.
- 1.2 *Allowance*: A specified dollar amount for a particular scope of work or service included in the Work that is identified in the Bid Documents and included in each Bidder's Bid. The Contractor shall document expenditures for an Allowance during the Project. Any unused balance shall be credited to the Owner. The Contractor is responsible for notifying the Owner of anticipated expenses greater than the specified amount and the Owner is responsible for those additional expenses.
- 1.3 *Alternate Bid*: The Contractor's written offer of a specified dollar amount, submitted on the Bid Form, for the performance of a particular scope of work described in the Bid Documents. The Owner determines the low bidder based on the sum of the base Bid and any combination of Alternate Bids that the Owner selects.
- 1.4 *Architect*: A Consultant acting as, or supporting, the Professional-of-Record who is responsible for the design of the Project. Equivalent to "Consultant" in State of Maine contract forms.
- 1.5 *Architectural Supplemental Instruction (ASI)*: A written instruction from the Architect for the purpose of clarification of the Contract Documents. An ASI does not alter the Contract Price or Contract Time. ASIs may be responses to RFIs and shall be issued by the Architect in a timely manner to avoid any negative impact on the Schedule of Work.
- 1.6 *Bid*: The Contractor's written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of the Work. A Bid may include bonds or other requirements. A base Bid is separate and distinct from Alternate Bids, being the only cost component necessary for the award of the contract, and representing the minimum amount of Work that is essential for the functioning of the Project.
- 1.7 *Bid Bond*: The security designated in the Bid Documents, furnished by Bidders as a guaranty of good faith to enter into a contract with the Owner, should a contract be awarded to that Bidder.
- 1.8 *Bidder*: Any business entity, individual or corporation that submits a bid for the performance of the work described in the Bid Documents, acting directly or through a duly authorized representative.
- 1.9 *Bid Documents*: The drawings, procurement and contracting requirements, general requirements, and the written specifications -including all addenda, that a bidder is required to reference in the submission of a bid.
- 1.10 *Bureau*: The State of Maine Bureau of Real Estate Management (formerly known as Bureau of General Services, or BGS) in the Department of Administrative and Financial Services.
- 1.11 *Calendar days*: Consecutive days, as occurring on a calendar, taking into account each day of the week, month, year, and any religious, national or local holidays. Calendar days are used for changes in Contract Time.
- 1.12 *Certificate of Substantial Completion*: A document developed by the Consultant that describes the final status of the Work and establishes the date that the Owner may use the facility for its intended

00 71 00
Definitions

purpose. The Certificate of Substantial Completion may also include a provisional list of items - a "punch list" - remaining to be completed by the Contractor. The Certificate of Substantial Completion identifies the date from which the project warranty period commences.

- 1.13 *Certificate of Occupancy*: A document developed by a local jurisdiction such as the Code Enforcement Officer that grants permission to the Owner to occupy a building.
- 1.14 *Change Order (CO)*: A document that modifies the contract and establishes the basis of a specific adjustment to the Contract Price or the Contract Time, or both. Change Orders may address correction of omissions, errors, and document discrepancies, or additional requirements. Change Orders should include all labor, materials and incidentals required to complete the work described. A Change Order is not valid until signed by the Contractor, Owner and Consultant and approved by the Bureau.
- 1.15 *Change Order Proposal (COP) (see also Proposal)*: Contract change proposed by the Contractor regarding the contract amount, requirements, or time. The Contractor implements the work of a COP after it is accepted by all parties. Accepted COPs are incorporated into the contract by Change Order.
- 1.16 *Clerk of the Works*: The authorized representative of the Consultant on the job site. Clerk of the Works is sometimes called the Architect's representative.
- 1.17 *Construction Change Directive (CCD)*: A written order prepared by the Consultant and signed by the Owner and Consultant, directing a change in the Work prior to final agreement with the Contractor on adjustment, if any, in the Contract Price or Contract Time, or both.
- 1.18 *Contract*: A written agreement between the Owner and the successful bidder which obligates the Contractor to perform the work specified in the Contract Documents and obligates the Owner to compensate the Contractor at the mutually accepted sum, rates or prices.
- 1.19 *Contract Bonds (also known as Payment and Performance Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.20 *Contract Documents*: The drawings and written specifications (including all addenda), Standard General Conditions, and the contract (including all Change Orders subsequently incorporated in the documents).
- 1.21 *Contract Price*: The dollar amount of the construction contract, also called *Contract Sum*.
- 1.22 *Contract Time*: The designated duration of time to execute the Work of the contract, with a specific date for completion.
- 1.23 *Contractor*: Also called the "General Contractor" or "GC" the individual or entity undertaking the execution of the general contract work under the terms of the contract with the Owner, acting directly or through a duly authorized representative. The Contractor is responsible for the means, methods and materials utilized in the execution and completion of the Work.
- 1.24 *Consultant*: The Architect or Engineer acting as Professional-of-Record for the Project. The Consultant is responsible for the design of the Project.

00 71 00
Definitions

- 1.25 *Drawings*: The graphic and pictorial portion of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.
- 1.26 *Engineer*: A Consultant acting as, or supporting, the Professional-of-Record who is responsible for the design of the Project. Equivalent to “Consultant” in State of Maine contract forms.
- 1.27 *Filed Sub-bid*: The designated major Subcontractor's (or, in some cases, Contractor's) written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of a particular portion of the Work. A Filed Sub-bid may include bonds or other requirements.
- 1.28 *Final Completion*: Project status establishing the date when the Work is fully completed in compliance with the Contract Documents, as certified by the Consultant. Final payment to the Contractor is due upon Final Completion of the Project.
- 1.29 *General Requirements*: The on-site overhead expense items the Contractor provides for the Project, typically including, but not limited to, building permits, construction supervision, Contract Bonds, insurance, field office, temporary utilities, rubbish removal, and site fencing. Overhead expenses of the Contractor's general operation are not included. Sometimes referred to as the Contractor's General Conditions.
- 1.30 *Owner*: The State agency which is represented by duly authorized individuals. The Owner is responsible for defining the scope of the Project and compensation to the Consultant and Contractor.
- 1.31 *Owner's Representative*: The individual or entity contracted by the Owner to be an advisor and information conduit regarding the Project.
- 1.32 *Overhead*: General and administrative expenses of the Contractor's principal and branch offices, including payroll costs and other compensation of Contractor employees, deductibles paid on any insurance policy, charges against the Contractor for delinquent payments, and costs related to the correction of defective work, and the Contractor's capital expenses, including interest on capital used for the work.
- 1.33 *Performance and Payment Bonds (also known as Contract Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.34 *Post-Bid Addendum*: Document issued by the Consultant that defines a potential Change Order prior to signing of the construction contract. The Post-Bid Addendum allows the Owner to negotiate contract changes with the Bidder submitting the lowest valid bid, only if the negotiated changes to the Bid Documents result in no change or no increase in the bid price.

A Post-Bid Addendum may also be issued after a competitive construction Bid opening to those Bidders who submitted a Bid initially, for the purpose of rebidding the Project work without re-advertising.

00 71 00
Definitions

- 1.35 *Project*: The construction project proposed by the Owner to be constructed according to the Contract Documents. The Project, a public improvement, may be tied logistically to other public improvements and other activities conducted by the Owner or other contractors.
- 1.36 *Proposal (see also Change Order Proposal)*: The Contractor's written offer submitted to the Owner for consideration containing a specified dollar amount or rate, for a specific scope of work, and including a schedule impact, if any. A proposal shall include all costs for overhead and profit. The Contractor implements the work of a Proposal after it is accepted by all parties. Accepted Proposals are incorporated into the contract by Change Order.
- 1.37 *Proposal Request (PR)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.38 *Punch List*: A document that identifies the items of work remaining to be done by the Contractor at the Close Out of a Project. The Punch List is created as a result of a final inspection of the work only after the Contractor attests that all of the Work is in its complete and permanent status.
- 1.39 *Request For Information (RFI)*: A Contractor's written request to the Consultant for clarification, definition or description of the Work. RFIs shall be presented by the Contractor in a timely manner to avoid any negative impact on the Schedule of Work.
- 1.40 *Request For Proposal (RFP)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.41 *Requisition for Payment*: The document in which the Contractor certifies that the Work described is, to the best of the Contractor's knowledge, information and belief, complete and that all previous payments have been paid by the Contractor to Subcontractors and suppliers, and that the current requested payment is now due. See *Schedule of Values*.
- 1.42 *Retainage*: The amount, calculated at five percent (5%) of the contract value or a scheduled value, that the Owner shall withhold from the Contractor until the work or portion of work is declared substantially complete or otherwise accepted by the Owner. The Owner may, if requested, reduce the amount withheld if the Owner deems it desirable and prudent to do so. (See Title 5 M.R.S.A., Section 1746.)
- 1.43 *Sample*: A physical example provided by the Contractor which illustrates materials, equipment or workmanship and establishes standards by which the Work will be judged.
- 1.44 *Schedule of the Work*: The document prepared by the Contractor and approved by the Owner that specifies the dates on which the Contractor plans to begin and complete various parts of the Work, including dates on which information and approvals are required from the Owner.
- 1.45 *Schedule of Values*: The document prepared by the Contractor and approved by the Owner before the commencement of the Work that specifies the dollar values of discrete portions of the Work equal in sum to the contract amount. The Schedule of Values is used to document progress payments of the Work in regular (usually monthly) requisitions for payment. See *Requisition for Payment*.
- 1.46 *Shop Drawings*: The drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

00 71 00
Definitions

- 1.47 *Specifications*: The portion of the Contract Documents consisting of the written requirements of the Work for materials, equipment, systems, standards, workmanship, and performance of related services.
- 1.48 *Subcontractor*: An individual or entity undertaking the execution of any part of the Work by virtue of a written agreement with the Contractor or any other Subcontractor. Also, an individual or entity retained by the Contractor or any other Subcontractor as an independent contractor to provide the labor, materials, equipment or services necessary to complete a specific portion of the Work.
- 1.49 *Substantial Completion*: Project status indicating when the Work or a designated portion of the Work is sufficiently complete in compliance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended purpose without unscheduled disruption. Substantial Completion is documented by the date of the Certificate of Substantial Completion signed by the Owner and the Contractor.
- 1.50 *Superintendent*: The representative of the Contractor on the job site, authorized by the Contractor to receive and fulfill instructions from the Consultant.
- 1.51 *Surety*: The individual or entity that is legally bound with the Contractor and Subcontractor to insure the faithful performance of the contract and for the payment of the bills for labor, materials and equipment by the Contractor and Subcontractors.
- 1.52 *Work*: The construction and services, whether completed or partially completed, including all labor, materials, equipment and services provided or to be provided by the Contractor and Subcontractors to fulfill the requirements of the Project as described in the Contract Documents.

00 72 13
General Conditions

Table of Contents of this General Conditions Section

1. Preconstruction Conference2

2. Intent and Correlation of Contract Documents.....2

3. Additional Drawings and Specifications3

4. Ownership of Contract Documents3

5. Permits, Laws, and Regulations3

6. Taxes4

7. Labor and Wages.....4

8. Indemnification5

9. Insurance Requirements5

10. Contract Bonds.....7

11. Patents and Royalties8

12. Surveys, Layout of Work8

13. Record of Documents.....8

14. Allowances8

15. Shop Drawings9

16. Samples9

17. Substitutions9

18. Assignment of Contract.....10

19. Separate Contracts.....10

20. Subcontracts10

21. Contractor-Subcontractor Relationship11

22. Supervision of the Work.....12

23. Observation of the Work12

24. Consultant's Status.....13

25. Management of the Premises13

26. Safety and Security of the Premises13

27. Changes in the Work15

28. Correction of the Work.....16

29. Owner's Right to do Work.....17

30. Termination of Contract and Stop Work Action17

31. Delays and Extension of Time18

32. Payments to the Contractor18

33. Payments Withheld19

34. Liens20

35. Workmanship20

36. Close-out of the Work21

37. Date of Completion and Liquidated Damages21

38. Dispute Resolution22

00 72 13
General Conditions

1. Preconstruction Conference

- 1.1 The Contractor shall, upon acceptance of a contract and prior to commencing work, schedule a preconstruction conference with the Owner and Consultant. The purpose of this conference is as follows.
 - 1.1.1 Introduce all parties who have a significant role in the Project, including:
 - Owner (State agency or other contracting entity)
 - Owner's Representative
 - Consultant (Architect or Engineer)
 - Subconsultants
 - Clerk-of-the-works
 - Contractor (GC)
 - Superintendent
 - Subcontractors
 - Other State agencies
 - Construction testing company
 - Commissioning agent
 - Special Inspections agent
 - Bureau of Real Estate Management (BREM);
 - 1.1.2 Review the responsibilities of each party;
 - 1.1.3 Review any previously-identified special provisions of the Project;
 - 1.1.4 Review the Schedule of the Work calendar submitted by the Contractor to be approved by the Owner and Consultant;
 - 1.1.5 Review the Schedule of Values form submitted by the Contractor to be approved by the Owner and Consultant;
 - 1.1.6 Establish routines for Shop Drawing approval, contract changes, requisitions, et cetera;
 - 1.1.7 discuss jobsite issues;
 - 1.1.8 Discuss Project close-out procedures;
 - 1.1.9 Provide an opportunity for clarification of Contract Documents before work begins; and
 - 1.1.10 Schedule regular meetings at appropriate intervals for the review of the progress of the Work.

2. Intent and Correlation of Contract Documents

- 2.1 The intent of the Contract Documents is to describe the complete Project. The Contract Documents consist of various components; each component complements the others. What is shown as a requirement by any one component shall be inferred as a requirement on all corresponding components.
- 2.2 The Contractor shall furnish all labor, equipment and materials, tools, transportation, insurance, services, supplies, operations and methods necessary for, and reasonably incidental to, the construction and completion of the Project. Any work that deviates from the Contract Documents which appears to be required by the exigencies of construction or by inconsistencies in the Contract Documents, will be determined by the Consultant and authorized in writing by the Consultant, Owner and the Bureau prior to execution. The Contractor shall be responsible for requesting clarifying information where the intent of the Contract Documents is uncertain.
- 2.3 The Contractor shall not utilize any apparent error or omission in the Contract Documents to the disadvantage of the Owner. The Contractor shall promptly notify the Consultant in writing of such errors or omissions. The Consultant shall make any corrections or clarifications necessary in such a situation to document the true intent of the Contract Documents.

00 72 13
General Conditions

3. Additional Drawings and Specifications

- 3.1 Upon the written request of the Contractor, the Owner shall provide, at no expense to the Contractor, up to five sets of printed Drawings and Specifications for the execution of the Work.
- 3.2 The Consultant shall promptly furnish to the Contractor revised Drawings and Specifications, for the area of the documents where those revisions apply, when corrections or clarifications are made by the Consultant. All such information shall be consistent with, and reasonably inferred from, the Contract Documents. The Contractor shall do no work without the proper Drawings and Specifications.

4. Ownership of Contract Documents

- 4.1 The designs represented on the Contract Documents are the property of the Consultant. The Drawings and Specifications shall not be used on other work without consent of the Consultant.

5. Permits, Laws, and Regulations

- 5.1 The Owner is responsible for obtaining any zoning approvals or other similar local project approvals necessary to complete the Work, unless otherwise specified in the Contract Documents.
- 5.2 The Owner is responsible for obtaining Maine Department of Environmental Protection, Maine Department of Transportation, or other similar state government project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.
- 5.3 The Owner is responsible for obtaining any federal agency project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.
- 5.4 The Owner is responsible for obtaining all easements for permanent structures or permanent changes in existing facilities.
- 5.5 The Contractor is responsible for obtaining and paying for all permits and licenses necessary for the implementation of the Work. The Contractor shall notify the Owner of any delays, variance or restrictions that may result from the issuing of permits and licenses.
- 5.6 The Contractor shall comply with all ordinances, laws, rules and regulations and make all required notices bearing on the implementation of the Work. In the event the Contractor observes disagreement between the Drawings and Specifications and any ordinances, laws, rules and regulations, the Contractor shall promptly notify the Consultant in writing. Any necessary changes shall be made as provided in the contract for changes in the work. The Contractor shall not perform any work knowing it to be contrary to such ordinances, laws, rules and regulations.
- 5.7 The Contractor shall comply with local, state and federal regulations regarding construction safety and all other aspects of the Work.
- 5.8 The Contractor shall comply with the Maine Code of Fair Practices and Affirmative Action, 5 M.R.S. §784 (2).

00 72 13
General Conditions

6. Taxes

- 6.1 The Owner is exempt from the payment of Maine State sales and use taxes as provided in 36 M.R.S. §1760 (1). The Contractor and Subcontractors shall not include taxes on exempt items in the construction contract.
- 6.2 Section 1760 further provides in subsection 61 that sales to a construction contractor or its subcontractor of tangible personal property that is to be physically incorporated in, and become a permanent part of, real property for sale to or owned by the Owner, are exempt from Maine State sales and use taxes. Tangible personal property is defined in 36 M.R.S. §1752 (17).
- 6.3 The Contractor may contact Maine Revenue Services, 24 State House Station, Augusta, Maine 04333 for guidance on tax exempt regulations authorized by 36 M.R.S. §1760 and detailed in Rule 302 (18-125 CMR 302).

7. Labor and Wages

- 7.1 The Contractor shall conform to the labor laws of the State of Maine, and all other laws, ordinances, and legal requirements affecting the work in Maine.
- 7.2 The Consultant shall include a wage determination document prepared by the Maine Department of Labor in the Contract Documents for state-funded contracts in excess of \$50,000. The document shows the minimum wages required to be paid to each category of labor employed on the project.
- 7.3 On projects requiring a Maine wage determination, the Contractor shall submit monthly payroll records to the Owner ("the contracting agency") showing the name and occupation of all workers and all independent contractors employed on the project. The monthly submission must also include the Contractor's company name, the title of the project, hours worked, hourly rate or other method of remuneration, and the actual wages or other compensation paid to each person.
- 7.4 The Contractor shall not reveal, in the payroll records submitted to the Owner, personal information regarding workers and independent contractors, other than the information described above. Such information shall not include Social Security number, employee identification number, or employee address or phone number, for example.
- 7.5 The Contractor shall conform to Maine statute (39-A M.R.S. §105-A (6)) by providing to the Workers' Compensation Board a list of all subcontractors and independent contractors on the job site and a record of the entity to whom that subcontractor or independent contractor is directly contracted and by whom that subcontractor or independent contractor is insured for workers' compensation purposes.
- 7.6 The Contractor shall enforce strict discipline and good order among their employees at all times, and shall not employ any person unfit or unskilled to do the work assigned to them.
- 7.7 The Contractor shall promptly pay all employees when their compensation is due, shall promptly pay all others who have billed and are due for materials, supplies and services used in the Work, and shall promptly pay all others who have billed and are due for insurance, workers compensation coverage, federal and state unemployment compensation, and Social Security

00 72 13
General Conditions

charges pertaining to this Project. Before final payments are made, the Contractor shall furnish to the Owner affidavits that all such payments described above have been made.

- 7.8 The Contractor may contact the Maine Department of Labor, 54 State House Station, Augusta, Maine 04333 for guidance on labor issues.
- 7.9 The Contractor may contact the Maine Workers' Compensation Board, 27 State House Station, Augusta, Maine 04333 for guidance on workers' compensation issues.

8. Indemnification

- 8.1 The Contractor shall indemnify and hold harmless the Owner and its officers and employees from and against any and all damages, liabilities, and costs, including reasonable attorney's fees, and defense costs, for any and all injuries to persons or property, including claims for violation of intellectual property rights, to the extent caused by the negligent acts or omissions of the Contractor, its employees, agents, officers or subcontractors in the performance of work under this Agreement. The Contractor shall not be liable for claims to the extent caused by the negligent acts or omissions of the Owner or for actions taken in reasonable reliance on written instructions of the Owner.
- 8.2 The Contractor shall notify the Owner promptly of all claims arising out of the performance of work under this Agreement by the Contractor, its employees or agents, officers or subcontractors.
- 8.3 This indemnity provision shall survive the termination of the Agreement, completion of the project or the expiration of the term of the Agreement.

9. Insurance Requirements

- 9.1 The Contractor shall provide, with each original of the signed Contract, an insurance certificate or certificates acceptable to the Owner and BREM. The Contractor shall submit insurance certificates to the Owner and BREM at the commencement of this Contract and at policy renewal or revision dates. The certificates shall identify the project name and BREM project number, and shall name the Owner as certificate holder and as additional insured for general liability and automobile liability coverages. The submitted forms shall contain a provision that coverage afforded under the insurance policies will not be canceled or materially changed unless at least ten days prior written notice by registered letter has been given to the Owner and BREM.
- 9.2 The Owner does not warrant or represent that the insurance required herein constitutes an insurance portfolio which adequately addresses all risks faced by the Contractor or its Subcontractors. The Contractor is responsible for the existence, extent and adequacy of insurance prior to commencement of work. The Contractor shall not allow any Subcontractor to commence work until all similar insurance required of the Subcontractor has been confirmed by the Contractor.
- 9.3 The Contractor shall procure and maintain primary insurance for the duration of the Project and, if written on a Claims-Made basis, shall also procure and maintain Extended Reporting Period (ERP) insurance for the period of time that any claims could be brought. The Contractor shall ensure that all Subcontractors they engage or employ will procure and maintain similar insurance

00 72 13
General Conditions

in form and amount acceptable to the Owner and BREM. At a minimum, the insurance shall be of the types and limits set forth herein protecting the Contractor from claims which may result from the Contractor’s execution of the Work, whether such execution be by the Contractor or by those employed by the Contractor or by those for whose acts they may be liable. All required insurance coverages shall be placed with carriers authorized to conduct business in the State of Maine by the Maine Bureau of Insurance.

9.3.1 The Contractor shall have Workers’ Compensation insurance for all employees on the Project site in accordance with the requirements of the Workers’ Compensation law of the State of Maine. Minimum acceptable limits for Employer’s Liability are:

Bodily Injury by Accident.....	\$500,000
Bodily Injury by Disease.....	\$500,000 Each Employee
Bodily Injury by Disease.....	\$500,000 Policy Limit

9.3.2 The Contractor shall have Commercial General Liability insurance providing coverage for bodily injury and property damage liability for all hazards of the Project including premise and operations, products and completed operations, contractual, and personal injury liabilities. The policy shall include collapse and underground coverage as well as explosion coverage if explosion hazards exist. Aggregate limits shall apply on a location or project basis. Minimum acceptable limits are:

General aggregate limit.....	\$2,000,000
Products and completed operations aggregate	\$1,000,000
Each occurrence limit.....	\$1,000,000
Personal injury aggregate.....	\$1,000,000

9.3.3 The Contractor shall have Automobile Liability insurance against claims for bodily injury, death or property damage resulting from the maintenance, ownership or use of all owned, non-owned and hired automobiles, trucks and trailers. Minimum acceptable limit is:

Any one accident or loss	\$500,000
--------------------------------	-----------

9.3.4 The Contractor shall have Owner’s Protective Liability insurance for contract values \$50,000 and above, naming the Owner as the Named Insured. Minimum acceptable limits are:

General aggregate limit.....	\$2,000,000
Each occurrence limit.....	\$1,000,000

9.4 The Owner has determined the appropriate coverage for this particular project, verified the coverage with the State of Maine Division of Risk Management, and selected the proper option on the contract form. Property Insurance for this construction contract shall one of the options described below.

9.4.1 Non-standard project insured by the Contractor –
Projects of this type include, but are not limited to, site improvements such as parking lots, boat launches, utility runs, and free-standing mechanical or electrical equipment, and do not necessarily include buildings. The Contractor shall procure and maintain an appropriate level of property insurance naming the Owner, Contractor and any Subcontractors as insureds as their interest may appear. Covered cause of loss form shall be all Risks of Direct Physical Loss, endorsed to include flood, earthquake, transit and sprinkler leakage where sprinkler coverage is applicable. Unless specifically authorized in writing by the Owner, the limit of insurance shall not be less than the initial contract amount and coverage shall apply during the entire contract period until the Certificate of Substantial Completion is accepted by the Owner.

00 72 13
General Conditions

- 9.4.2 New construction insured by the Contractor –
The Contractor shall procure and maintain Builder's Risk insurance naming the Owner, Contractor and any Subcontractors as insureds as their interest may appear. Covered cause of loss form shall be all Risks of Direct Physical Loss, endorsed to include flood, earthquake, transit and sprinkler leakage where sprinkler coverage is applicable. Unless specifically authorized in writing by the Owner, the limit of insurance shall not be less than the initial contract amount and coverage shall apply during the entire contract period until the Certificate of Substantial Completion is accepted by the Owner.
- 9.4.3 Renovations and additions to existing State-owned buildings insured by the Owner (State of Maine Division of Risk Management) –
Builder's Risk insurance will be provided by the State of Maine in accordance with the terms and conditions of the State's property policy. The Owner shall notify Maine Division of Risk Management concerning the project, including the nature and value of the work, planned start and completion date, and the name of the General Contractor. Said insurance coverage shall cover the interests of the Contractor and Subcontractor, as their interests may appear. Exclusions common to commercial property policies may be applicable. A Builder's Risk certificate of insurance will be furnished to the Contractor upon request.
- The \$500 per occurrence deductible is the responsibility of the Contractor. Should the Contractor or Subcontractor desire coverage in excess of that maintained by the State, it must be acquired by the Contractor and at Contractor expense.
- 9.4.4 Renovations and additions to existing buildings not insured by the Owner (State of Maine Division of Risk Management) –
The Contractor shall procure and maintain Builder's Risk insurance naming the Owner, Contractor and all Subcontractors as insureds as their interests may appear. The covered cause of loss form shall be Risks of Direct Physical Loss, endorsed to include flood, earthquake, testing and ensuing loss and shall include coverage for materials in transit and materials stored off site. Coverage shall be on a replacement cost and a completed value basis. Unless specifically authorized by the Owner, the limit of insurance shall not be less than the contract amount and coverage shall apply during the entire contract period until the Certificate of Substantial Completion is accepted by the Owner.

10. Contract Bonds

- 10.1 When noted as required in the Bid Documents, the Contractor shall provide to the Owner a Performance Bond and a Payment Bond, or "contract bonds", upon execution of the contract. Each bond value shall be for the full amount of the contract and issued by a surety company authorized to do business in the State of Maine as approved by the Owner. The bonds shall be executed on the forms furnished in the Bid Documents. The bonds shall allow for any subsequent additions or deductions of the contract.
- 10.2 The contract bonds shall continue in effect for one year after final acceptance of the contract to protect the Owner's interest in connection with the one year guarantee of workmanship and materials and to assure settlement of claims for the payment of all bills for labor, materials and equipment by the Contractor.

00 72 13
General Conditions

11. Patents and Royalties

- 11.1 The Contractor shall, for all time, secure for the Owner the free and undisputed right to the use of any patented articles or methods used in the Work. The expense of defending any suits for infringement or alleged infringement of such patents shall be borne by the Contractor. Awards made regarding patent suits shall be paid by the Contractor. The Contractor shall hold the Owner harmless regarding patent suits that may arise due to installations made by the Contractor, and to any awards made as a result of such suits.
- 11.2 Any royalty payments related to the work done by the Contractor for the Project shall be borne by the Contractor. The Contractor shall hold the Owner harmless regarding any royalty payments that may arise due to installations made by the Contractor.

12. Surveys, Layout of Work

- 12.1 The Owner shall furnish all property surveys unless otherwise specified.
- 12.2 The Contractor is responsible for correctly staking out the Work on the site. The Contractor shall employ a competent surveyor to position all construction on the site. The surveyor shall run the axis lines, establish correct datum points and check each line and point on the site to insure their accuracy. All such lines and points shall be carefully preserved throughout the construction.
- 12.3 The Contractor shall lay out all work from dimensions given on the Drawings. The Contractor shall take measurements and verify dimensions of any existing work that affects the Work or to which the Work is to be fitted. The Contractor is solely responsible for the accuracy of all measurements. The Contractor shall verify all grades, lines, levels, elevations and dimensions shown on the Drawings and report any errors or inconsistencies to the Consultant prior to commencing work.

13. Record of Documents

- 13.1 The Contractor shall maintain one complete set of Contract Documents on the jobsite, in good order and current status, for access by the Owner and Consultant.
- 13.2 The Contractor shall maintain, continuously updated, complete records of Requests for Information, Architectural Supplemental Instructions (or equivalent), Information Bulletins, supplemental sketches, Change Order Proposals, Change Orders, Shop Drawings, testing reports, et cetera, for access by the Owner and Consultant.

14. Allowances

- 14.1 The Contract Price shall include all allowances described in the Contract Documents. The Contractor shall include all overhead and profit necessary to implement each allowance in their Contract Price.
- 14.2 The Contractor shall not be required to employ parties for allowance work against whom the Contractor has a reasonable objection. In such a case, the Contractor shall notify the Owner in writing of their position and shall propose an alternative party to complete the work of the allowance.

00 72 13
General Conditions

15. Shop Drawings

- 15.1 The Contractor shall administer Shop Drawings prepared by the Contractor, Subcontractors, suppliers or others to conform to the approved Schedule of the Work. The Contractor shall verify all field measurements, check and authorize all Shop Drawings and schedules required by the Work. The Contractor is the responsible party and contact for the Contractor's work as well as that of Subcontractors, suppliers or others who provide Shop Drawings.
- 15.2 The Consultant shall review and acknowledge Shop Drawings, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents.
- 15.3 The Contractor shall provide monthly updated logs containing: requests for information, information bulletins, supplemental instructions, supplemental sketches, change order proposals, change orders, submittals, testing and deficiencies.
- 15.4 The Contractor shall make any corrections required by the Consultant, and shall submit a quantity of corrected copies as may be needed. The acceptance of Shop Drawings or schedules by the Consultant shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications, unless the Contractor has called such deviations to the attention of the Consultant at the time of submission and secured the Consultant's written approval. The acceptance of Shop Drawings or schedules by the Consultant does not relieve the Contractor from responsibility for errors in Shop Drawings or schedules.

16. Samples

- 16.1 The Contractor shall furnish for approval, with reasonable promptness, all samples as directed by the Consultant. The Consultant shall review and approve such samples, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents. The subsequent work shall be in accord with the approved samples.

17. Substitutions

- 17.1 The Contractor shall furnish items and materials described in the Contract Documents. If the item or material specified describes a proprietary product, or uses the name of a manufacturer, the term "or approved equal" shall be implied, if it is not included in the text. The specific item or material specified establishes a minimum standard for the general design, level of quality, type, function, durability, efficiency, reliability, compatibility, warranty coverage, installation factors and required maintenance. The Drawing or written Specification shall not be construed to exclude other manufacturers products of comparable design, quality, and efficiency.
- 17.2 The Contractor may submit detailed information about a proposed substitution to the Consultant for consideration. Particular models of items and particular materials which the Contractor asserts to be equal to the items and materials identified in the Contract Documents shall be allowed only with written approval by the Consultant. The request for substitution shall include a cost comparison and a reason or reasons for the substitution.
- 17.3 The Consultant may request additional information about the proposed substitution. The approval or rejection of a proposed substitution may be based on timeliness of the request, source

00 72 13
General Conditions

of the information, the considerations of minimum standards described above, or other considerations. The Consultant should briefly state the rationale for the decision. The decision shall be considered final.

- 17.4 The duration of a substitution review process can not be the basis for a claim for delay in the Schedule of the Work.

18. Assignment of Contract

- 18.1 The Contractor shall not assign or sublet the contract as a whole without the written consent of the Owner. The Contractor shall not assign any money due to the Contractor without the written consent of the Owner.

19. Separate Contracts

- 19.1 The Owner reserves the right to create other contracts in connection with this Project using similar General Conditions. The Contractor shall allow the Owner's other contractors reasonable opportunity for the delivery and storage of materials and the execution of their work. The Contractor shall coordinate and properly connect the Work of all contractors.
- 19.2 The Contractor shall promptly report to the Consultant and Owner any apparent deficiencies in work of the Owner's other contractors that impacts the proper execution or results of the Contractor. The Contractor's failure to observe or report any deficiencies constitutes an acceptance of the Owner's other contractors work as suitable for the interface of the Contractor's work, except for latent deficiencies in the Owner's other contractors work.
- 19.3 Similarly, the Contractor shall promptly report to the Consultant and Owner any apparent deficiencies in their own work that would impact the proper execution or results of the Owner's other contractors.
- 19.4 The Contractor shall report to the Consultant and Owner any conflicts or claims for damages with the Owner's other contractors and settle such conflicts or claims for damages by mutual agreement or arbitration, if necessary, at no expense to the Owner.
- 19.5 In the event the Owner's other contractors sue the Owner regarding any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor, who shall defend such proceedings at the Contractor's expense. The Contractor shall pay or satisfy any judgment that may arise against the Owner, and pay all other costs incurred.

20. Subcontracts

- 20.1 The Contractor shall not subcontract any part of this contract without the written permission of the Owner.
- 20.2 The Contractor shall submit a complete list of named Subcontractors and material suppliers to the Consultant and Owner for approval by the Owner prior to commencing work. The Subcontractors named shall be reputable companies of recognized standing with a record of satisfactory work.

00 72 13
General Conditions

- 20.3 The Contractor shall not employ any Subcontractor or use any material until they have been approved, or where there is reason to believe the resulting work will not comply with the Contract Documents.
- 20.4 The Contractor, not the Owner, is as fully responsible for the acts and omissions of Subcontractors and of persons employed by them, as the Contractor is for the acts and omissions of persons directly or indirectly employed by the Contractor.
- 20.5 Neither the Contract Documents nor any Contractor-Subcontractor contract shall indicate, infer or create any direct contractual relationship between any Subcontractor and the Owner.
21. Contractor-Subcontractor Relationship
- 21.1 The Contractor shall be bound to the Subcontractor by all the obligations in the Contract Documents that bind the Contractor to the Owner.
- 21.2 The Contractor shall pay the Subcontractor, in proportion to the dollar value of the work completed and requisitioned by the Subcontractor, the approved dollar amount allowed to the Contractor no more than seven days after receipt of payment from the Owner.
- 21.3 The Contractor shall pay the Subcontractor accordingly if the Contract Documents or the subcontract provide for earlier or larger payments than described in the provision above.
- 21.4 The Contractor shall pay the Subcontractor for completed and requisitioned subcontract work, less retainage, no more than seven days after receipt of payment from the Owner for the Contractor's approved Requisition for Payment, even if the Consultant fails to certify a portion of the Requisition for Payment for a cause not the fault of the Subcontractor.
- 21.5 The Contractor shall not make a claim for liquidated damages or penalty for delay in any amount in excess of amounts that are specified by the subcontract.
- 21.6 The Contractor shall not make a claim for services rendered or materials furnished by the Subcontractor unless written notice is given by the Contractor to the Subcontractor within ten calendar days of the day in which the claim originated.
- 21.7 The Contractor shall give the Subcontractor an opportunity to present and to submit evidence in any progress conference or disputes involving subcontract work.
- 21.8 The Contractor shall pay the Subcontractor a just share of any fire insurance payment received by the Contractor.
- 21.9 The Subcontractor shall be bound to the Contractor by the terms of the Contract Documents and assumes toward the Contractor all the obligations and responsibilities that the Contractor, by those documents, assumes toward the Owner.
- 21.10 The Subcontractor shall submit applications for payment to the Contractor in such reasonable time as to enable the Contractor to apply for payment as specified.

00 72 13
General Conditions

21.11 The Subcontractor shall make any claims for extra cost, extensions of time or damages, to the Contractor in the manner provided in these General Conditions for like claims by the Contractor to the Owner, except that the time for the Subcontractor to make claims for extra cost is seven calendar days after the receipt of Consultant's instructions.

22. Supervision of the Work

22.1 During all stages of the Work the Contractor shall have a competent superintendent, with any necessary assistant superintendents, overseeing the project. The superintendent shall not be reassigned without the consent of the Owner unless a superintendent ceases to be employed by the Contractor due to unsatisfactory performance.

22.2 The superintendent represents the Contractor on the jobsite. Directives given by the Consultant or Owner to the superintendent shall be as binding as if given directly to the Contractor's main office. All important directives shall be confirmed in writing to the Contractor. The Consultant and Owner are not responsible for the acts or omissions of the superintendent or assistant superintendents.

22.3 The Contractor shall provide supervision of the Work equal to the industry's highest standard of care. The superintendent shall carefully study and compare all Contract Documents and promptly report any error, inconsistency or omission discovered to the Consultant. The Contractor may not necessarily be held liable for damages resulting directly from any error, inconsistency or omission in the Contract Documents or other instructions by the Consultant that was not revealed by the superintendent in a timely way.

23. Observation of the Work

23.1 The Contractor shall allow the Owner, the Consultant and the Bureau continuous access to the site for the purpose of observation of the progress of the work. All necessary safeguards and accommodations for such observations shall be provided by the Contractor.

23.2 The Contractor shall coordinate all required testing, approval or demonstration of the Work. The Contractor shall give sufficient notice to the appropriate parties of readiness for testing, inspection or examination.

23.3 The Contractor shall schedule inspections and obtain all required certificates of inspection for inspections by a party other than the Consultant.

23.4 The Consultant shall make all scheduled observations promptly, prior to the work being concealed or buried by the Contractor. If approval of the Work is required of the Consultant, the Contractor shall notify the Consultant of the construction schedule in this regard. Work concealed or buried prior to the Consultant's approval may need to be uncovered at the Contractor's expense.

23.5 The Consultant may order reexamination of questioned work, and, if so ordered, the work must be uncovered by the Contractor. If the work is found to conform to the Contract Documents, the Owner shall pay the expense of the reexamination and remedial work. If the work is found to not conform to the Contract Documents, the Contractor shall pay the expense, unless the defect in the

00 72 13
General Conditions

work was caused by the Owner's Contractor, whose responsibility the reexamination expense becomes.

- 23.6 The Bureau shall periodically observe the Work during the course of construction and make recommendations to the Contractor or Consultant as necessary. Such recommendations shall be considered and implemented through the usual means for changes to the Work.

24. Consultant's Status

- 24.1 The Consultant represents the Owner during the construction period, and observes the work in progress on behalf of the Owner. The Consultant has authority to act on behalf of the Owner only to the extent expressly provided by the Contract Documents or otherwise demonstrated to the Contractor. The Consultant has authority to stop the work whenever such an action is necessary, in the Consultant's reasonable opinion, to ensure the proper execution of the contract.
- 24.2 The Consultant is the interpreter of the conditions of the contract and the judge of its performance. The Consultant shall favor neither the Owner nor the Contractor, but shall use the Consultant's powers under the contract to enforce faithful performance by both parties.
- 24.3 In the event of the termination of the Consultant's employment on the project prior to completion of the work, the Owner shall appoint a capable and reputable replacement. The status of the new Consultant relative to this contract shall be that of the former Consultant.

25. Management of the Premises

- 25.1 The Contractor shall place equipment and materials, and conduct activities on the premises in a manner that does not unreasonably hinder site circulation, environmental stability, or any long term effect. Likewise, the Consultant's directions shall not cause the use of premises to be impeded for the Contractor or Owner.
- 25.2 The Contractor shall not use the premises for any purpose other than that which is directly related to the scope of work. The Owner shall not use the premises for any purpose incompatible with the proposed work simultaneous to the work of the Contractor.
- 25.3 The Contractor shall enforce the Consultant's instructions regarding information posted on the premises such as signage and advertisements, as well as activities conducted on the premises such as fires, and smoking.
- 25.4 The Owner may occupy any part of the Project that is completed with the written consent of the Contractor, and without prejudice to any of the rights of the Owner or Contractor. Such use or occupancy shall not, in and of itself, be construed as a final acceptance of any work or materials.

26. Safety and Security of the Premises

- 26.1 The Contractor shall designate, and make known to the Consultant and the Owner, a safety officer whose duty is the prevention of accidents on the site.

00 72 13
General Conditions

- 26.2 The Contractor shall continuously maintain security on the premises and protect from unreasonable occasion of injury all people authorized to be on the job site. The Contractor shall also effectively protect the property and adjacent properties from damage or loss.
- 26.3 The Contractor shall take all necessary precautions to ensure the safety of workers and others on and adjacent to the site, abiding by applicable local, state and federal safety regulations. The Contractor shall erect and continuously maintain safeguards for the protection of workers and others, and shall post signs and other warnings regarding hazards associated with the construction process, such as protruding fasteners, moving equipment, trenches and holes, scaffolding, window, door or stair openings, and falling materials.
- 26.4 The Contractor shall restore the premises to conditions that existed prior to the start of the project at areas not intended to be altered according to the Contract Documents.
- 26.5 The Contractor shall protect existing utilities and exercise care working in the vicinity of utilities shown in the Drawings and Specifications or otherwise located by the Contractor.
- 26.6 The Contractor shall protect from damage existing trees and other significant plantings and landscape features of the site which will remain a permanent part of the site. If necessary or indicated in the Contract Documents, tree trunks shall be boxed and barriers erected to prevent damage to tree branches or roots.
- 26.7 The Contractor shall repair or replace damage to the Work caused by the Contractor's or Subcontractor's forces, including that which is reasonably protected, at the expense of the responsible party.
- 26.8 The Contractor shall not load, or allow to be loaded, any part of the Project with a force which imperils personal or structural safety. The Consultant may consult with the Contractor on such means and methods of construction, however, the ultimate responsibility lies with the Contractor.
- 26.9 The Contractor shall not jeopardize any work in place with subsequent construction activities such as blasting, drilling, excavating, cutting, patching or altering work. The Consultant must approve altering any structural components of the project. The Contractor shall supervise all construction activities carried out by others on site to ensure that the work is neatly done and in a manner that will not endanger the structure or the component parts.
- 26.10 The Contractor may act with their sole discretion in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Contractor may negotiate with the Owner for compensation for expenses due to such emergency work.
- 26.11 The Contractor and Subcontractors shall have no responsibility for the identification, discovery, presence, handling, removal or disposal of, or exposure of persons to, hazardous materials in any form at the project site. The Contractor shall avoid disruption of any hazardous materials or toxic substances at the project site and promptly notify the Owner in writing on the occasion of such a discovery.

00 72 13
General Conditions

- 26.12 The Contractor shall keep the premises free of any unsafe accumulation of waste materials caused by the work. The Contractor shall regularly keep the spaces “broom clean”. See the Close-out of the Work provisions of this section regarding cleaning at the completion of the project.
27. Changes in the Work
- 27.1 The Contractor shall not proceed with extra work without an approved Change Order or Construction Change Directive. A Change Order which has been properly signed by all parties shall become a part of the contract.
- 27.2 A Change Order is the usual document for directing changes in the Work. In certain circumstances, however, the Owner may utilize a Construction Change Directive to direct the Contractor to perform changes in the Work that are generally consistent with the scope of the project. The Owner shall use a Construction Change Directive only when the normal process for approving changes to the Work has failed to the detriment of the Project, or when agreement on the terms of a Change Order cannot be met, or when an urgent situation requires, in the Owner's judgment, prompt action by the Contractor.
- 27.3 The Consultant shall prepare the Construction Change Directive representing a complete scope of work, with proposed Contract Price and Contract Time revisions, if any, clearly stated.
- 27.4 The Contractor shall promptly carry out a Construction Change Directive which has been signed by the Owner and the Consultant. Work thus completed by the Contractor constitutes the basis for a Change Order. Changes in the Contract Price and Contract Time shall be as defined in the Construction Change Directive unless subsequently negotiated with some other terms.
- 27.5 The method of determining the dollar value of extra work shall be by:
- .1 an estimate of the Contractor accepted by Owner as a lump sum, or
 - .2 unit prices named in the contract or subsequently agreed upon, or
 - .3 cost plus a designated percentage, or
 - .4 cost plus a fixed fee.
- 27.6 The Contractor shall determine the dollar value of the extra work for both the lump sum and cost plus designated percentage methods so as not to exceed the following rates. The rates include all overhead and profit expenses.
- .1 Contractor - for any work performed by the Contractor's own forces, up to 20% of the cost;
 - .2 Subcontractor - for work performed by Subcontractor's own forces, up to 20% of the cost;
 - .3 Contractor - for work performed by Contractor's Subcontractor, up to 10% of the amount due the Subcontractor.
- 27.7 The Contractor shall keep and provide records as needed or directed for the cost plus designated percentage method. The Consultant shall review and certify the appropriate amount which includes the Contractor's overhead and profit. The Owner shall make payments based on the Consultant's certificate.
- 27.8 Cost reflected in Change Orders shall be limited to the following: cost of materials, cost of delivery, cost of labor (including Social Security, pension, Workers' Compensation insurance, and unemployment insurance), and cost of rental of power tools and equipment. Labor cost may

00 72 13
General Conditions

- include a pro-ratio share of a foreman's time only in the case of an extension of contract time granted due to the Change Order.
- 27.9 Overhead reflected in Change Orders shall be limited to the following: bond premium, supervision, wages of clerks, time keepers, and watchmen, small tools, incidental expenses, general office expenses, and all other overhead expenses directly related to the Change Order.
- 27.10 The Contractor shall provide credit to the Owner for labor, materials, equipment and other costs but not overhead and profit expenses for those Change Order items that result in a net value of credit to the contract.
- 27.11 The Owner may change the scope of work of the Project without invalidating the contract. The Owner shall notify the Contractor of a change of the scope of work for the Owner's Contractors, which may affect the work of this Contractor, without invalidating the contract. Change Orders for extension of the time caused by such changes shall be developed at the time of directing the change in scope of work.
- 27.12 The Consultant may order minor changes in the Work, not involving extra cost, which is consistent with the intent of the design or project.
- 27.13 The Contractor shall immediately give written notification to the Consultant of latent conditions discovered at the site which materially differ from those represented in the Drawings or Specifications, and which may eventually result in a change in the scope of work. The Contractor shall suspend work until receiving direction from the Consultant. The Consultant shall promptly investigate the conditions and respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Consultant shall determine if the discovered conditions warrant a Change Order.
- 27.14 The Contractor shall, within ten calendar days of receipt of the information, give written notification to the Consultant if the Contractor claims that instructions by the Consultant will constitute extra cost not accounted for by Change Order or otherwise under the contract. The Consultant shall promptly respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Consultant shall determine if the Contractor's claim warrants a Change Order.
28. Correction of the Work
- 28.1 The Contractor shall promptly remove from the premises all work the Consultant declares is non-conforming to the contract. The Contractor shall replace the work properly at no expense to the Owner. The Contractor is also responsible for the expenses of others whose work was damaged or destroyed by such remedial work.
- 28.2 The Owner may elect to remove non-conforming work if it is not removed by the Contractor within a reasonable time, that time defined in a written notice from the Consultant. The Owner may elect to store removed non-conforming work not removed by the Contractor at the Contractor's expense. The Owner may, with ten days written notice, dispose of materials which the Contractor does not remove. The Owner may sell the materials and apply the net proceeds, after deducting all expenses, to the costs that should have been borne by the Contractor.

00 72 13
General Conditions

28.3 The Contractor shall remedy any defects due to faulty materials or workmanship and pay for any related damage to other work which appears within a period of one year from the date of substantial completion, and in accord with the terms of any guarantees provided in the contract. The Owner shall promptly give notice of observed defects to the Contractor and Consultant. The Consultant shall determine the status of all claimed defects. The Contractor shall perform all remedial work without unjustifiable delay in either the initial response or the corrective action.

28.4 The Consultant may authorize, after a reasonable notification to the Contractor, an equitable deduction from the contract amount in lieu of the Contractor correcting non-conforming or defective work.

29. Owner's Right to do Work

29.1 The Owner may, using other contractors, correct deficiencies attributable to the Contractor, or complete unfinished work. Such action shall take place only after giving the Contractor three days written notice, and provided the Consultant approves of the proposed course of action as an appropriate remedy. The Owner may then deduct the cost of the remedial work from the amount due the Contractor.

29.2 The Owner may act with their sole discretion when the Contractor is unable to take action in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Owner shall inform the Contractor of the emergency work performed, particularly where it may affect the work of the Contractor.

30. Termination of Contract and Stop Work Action

30.1 The Owner may, owing to a certificate of the Consultant indicating that sufficient cause exists to justify such action, without prejudice to any other right or remedy and after giving the Contractor and the Contractor's surety seven days written notice, terminate the employment of the Contractor. At that time the Owner may take possession of the premises and of all materials, tools and appliances on the premises and finish the work by whatever method the Owner may deem expedient. Cause for such action by the Owner includes:

- .1 the contractor is adjudged bankrupt, or makes a general assignment for the benefit of its creditors, or
- .2 a receiver is appointed due to the Contractor's insolvency, or
- .3 the Contractor persistently or repeatedly refuses or fails to provide enough properly skilled workers or proper materials, or
- .4 the Contractor fails to make prompt payment to Subcontractors or suppliers of materials or labor, or
- .5 the Contractor persistently disregards laws, ordinances or the instructions of the Consultant, or is otherwise found guilty of a substantial violation of a provision of the Contract Documents.

30.2 The Contractor is not entitled, as a consequence of the termination of the employment of the Contractor as described above, to receive any further payment until the Work is finished. If the unpaid balance of the contract amount exceeds the expense of finishing the Work, including compensation for additional architectural, managerial and administrative services, such balance

00 72 13
General Conditions

shall be paid to the Contractor. If the expense of finishing the Work exceeds the unpaid balance, the Contractor shall pay the difference to the Owner. The Consultant shall certify the expense incurred by the Contractor's default. This obligation for payment shall continue to exist after termination of the contract.

30.3 The Contractor may, if the Work is stopped by order of any court or other public authority for a period of thirty consecutive days, and through no act or fault of the Contractor or of anyone employed by the Contractor, with seven days written notice to the Owner and the Consultant, terminate this contract. The Contractor may then recover from the Owner payment for all work executed, any proven loss and reasonable profit and damage.

30.4 The Contractor may, if the Consultant fails to issue a certificate for payment within seven days after the Contractor's formal request for payment, through no fault of the Contractor, or if the Owner fails to pay to the Contractor within 30 days after submission of any sum certified by the Consultant, with seven days written notice to the Owner and the Consultant, stop the Work or terminate this Contract.

31. Delays and Extension of Time

31.1 The completion date of the contract shall be extended if the work is delayed by changes ordered in the work which have approved time extensions, or by an act or neglect of the Owner, the Consultant, or the Owner's Contractor, or by strikes, lockouts, fire, flooding, unusual delay in transportation, unavoidable casualties, or by other causes beyond the Contractor's control. The Consultant shall determine the status of all claimed causes.

31.2 The contract shall not be extended for delay occurring more than seven calendar days before the Contractor's claim made in writing to the Consultant. In case of a continuing cause of delay, only one claim is necessary.

31.3 The contract shall not be extended due to failure of the Consultant to furnish drawings if no schedule or agreement is made between the Contractor and the Consultant indicating the dates which drawings shall be furnished and fourteen calendar days has passed after said date for such drawings.

31.4 This article does not exclude the recovery of damages for delay by either party under other provisions in the Contract Document.

32. Payments to the Contractor

32.1 As noted under *Preconstruction Conference* in this section, the Contractor shall submit a Schedule of Values form, before the first application for payment, for approval by the Owner and Consultant. The Consultant may direct the Contractor to provide evidence that supports the correctness of the form. The approved Schedule of Values shall be used as a basis for payments.

32.2 The Contractor shall submit an application for each payment ("Requisition for Payment") on a form approved by the Owner and Consultant. The Consultant may require receipts or other documents showing the Contractor's payments for materials and labor, including payments to Subcontractors.

00 72 13
General Conditions

- 32.3 The Contractor shall submit Requisitions for Payment as the work progresses not more frequently than once each month, unless the Owner approves a more frequent interval due to unusual circumstances. The Requisition for Payment is based on the proportionate quantities of the various classes of work completed or incorporated in the Work, in agreement with the actual progress of the Work and the dollar value indicated in the Schedule of Values.
- 32.4 The Consultant shall verify and certify each Requisition for Payment which appears to be complete and correct prior to payment being made by the Owner. The Consultant may certify an appropriate amount for materials not incorporated in the Work which have been delivered and suitably stored at the site. The Contractor shall submit bills of sale, insurance certificates, or other such documents that will adequately protect the Owner's interests prior to payments being certified.
- 32.5 In the event any materials delivered but not yet incorporated in the Work have been included in a certified Requisition for Payment with payment made, and said materials thereafter are damaged, deteriorated or destroyed, or for any reason whatsoever become unsuitable or unavailable for use in the Work, the full amount previously allowed shall be deducted from subsequent payments unless the Contractor satisfactorily replaces said material.
- 32.6 The Contractor may request certification of an appropriate dollar amount for materials not incorporated in the Work which have been delivered and suitably stored away from the site. The Contractor shall submit bills of sale, insurance certificates, right-of-entry documents or other such documents that will adequately protect the Owner's interests. The Consultant shall determine if the Contractor's documentation for the materials is complete and specifically designated for the Project. The Owner may allow certification of such payments.
- 32.7 Subcontractors may request, and shall receive from the Consultant, copies of approved Requisitions for Payment showing the amounts certified in the Schedule of Values.
- 32.8 Certified Requisitions for Payment, payments made to the Contractor, or partial or entire occupancy of the project by the Owner shall not constitute an acceptance of any work that does not conform to the Contract Documents. The making and acceptance of the final payment constitutes a waiver of all claims by the Owner, other than those arising from unsettled liens, from faulty work or materials appearing within one year from final payment or from requirements of the Drawings and Specifications, and of all claims by the Contractor, except those previously made and still unsettled.
33. Payments Withheld
- 33.1 The Owner shall retain five percent of each payment due the Contractor as part security for the fulfillment of the contract by the Contractor. The Owner may make payment of a portion of this "retainage" to the Contractor temporarily or permanently during the progress of the Work. The Owner may thereafter withhold further payments until the full amount of the five percent is reestablished. The Contractor may deposit with the Maine State Treasurer certain securities in place of retainage amounts due according to Maine Statute (5 M.R.S. §1746).

00 72 13
General Conditions

- 33.2 The Consultant may withhold or nullify the whole or a portion of any Requisitions for Payment submitted by the Contractor in the amount that may be necessary, in his reasonable opinion, to protect the Owner from loss due to any of the following:
- .1 defective work not remedied;
 - .2 claims filed or reasonable evidence indicating probable filing of claims;
 - .3 failure to make payments properly to Subcontractors or suppliers;
 - .4 a reasonable doubt that the contract can be completed for the balance then unpaid;
 - .5 liability for damage to another contractor.

The Owner shall make payment to the Contractor, in the amount withheld, when the above circumstances are removed.

34. Liens

- 34.1 The Contractor shall deliver to the Owner a complete release of all liens arising out of this contract before the final payment or any part of the retainage payment is released. The Contractor shall provide with the release of liens an affidavit asserting each release includes all labor and materials for which a lien could be filed. Alternately, the Contractor, in the event any Subcontractor or supplier refuses to furnish a release of lien in full, may furnish a bond satisfactory to the Owner, to indemnify the Owner against any lien.
- 34.2 In the event any lien remains unsatisfied after all payments to the Contractor are made by the Owner, the Contractor shall refund to the Owner all money that the latter may be compelled to pay in discharging such lien, including all cost and reasonable attorney's fees.

35. Workmanship

- 35.1 The Contractor shall provide materials, equipment, and installed work equal to or better than the quality specified in the Contract Documents and approved in submittal and sample. The installation methods shall be of the highest standards, and the best obtainable from the respective trades. The Consultant's decision on the quality of work shall be final.
- 35.2 The Contractor shall know local labor conditions for skilled and unskilled labor in order to apply the labor appropriately to the Work. All labor shall be performed by individuals well skilled in their respective trades.
- 35.3 The Contractor shall perform all cutting, fitting, patching and placing of work in such a manner to allow subsequent work to fit properly, whether that be by the Contractor, the Owner's Contractors or others. The Owner and Consultant may advise the Contractor regarding such subsequent work. Notwithstanding the notification or knowledge of such subsequent work, the Contractor may be directed to comply with this standard of compatible construction by the Consultant at the Contractor's expense.
- 35.4 The Contractor shall request clarification or revision of any design work by the Consultant, prior to commencing that work, in a circumstance where the Contractor believes the work cannot feasibly be completed at the highest quality, or as indicated in the Contract Documents. The Consultant shall respond to such requests in a timely way, providing clarifying information, a feasible revision, or instruction allowing a reduced quality of work. The Contractor shall follow the direction of the Consultant regarding the required request for information.

00 72 13
General Conditions

35.5 The Contractor shall guarantee the Work against any defects in workmanship and materials for a period of one year commencing with the date of the Certificate of Substantial Completion, unless specified otherwise for specific elements of the project. The Work may also be subdivided in mutually agreed upon components, each defined by a separate Certificate of Substantial Completion.

36. Close-out of the Work

36.1 The Contractor shall remove from the premises all waste materials caused by the work. The Contractor shall make the spaces "broom clean" unless a more thorough cleaning is specified. The Contractor shall clean all windows and glass immediately prior to the final inspection, unless otherwise directed.

36.2 The Owner may conduct the cleaning of the premises where the Contractor, duly notified by the Consultant, fails to adequately complete the task. The expense of this cleaning may be deducted from the sum due to the Contractor.

36.3 The Contractor shall participate in all final inspections and acknowledge the documentation of unsatisfactory work, customarily called the "punch list", to be corrected by the Contractor. The Consultant shall document the successful completion of the Work in a dated Certificate of Substantial Completion, to be signed by Owner, Consultant, and Contractor.

36.4 The Contractor shall not call for final inspection of any portion of the Work that is not completely and permanently installed. The Contractor may be found liable for the expenses of individuals called to final inspection meetings prematurely.

36.5 The Contractor and all major Subcontractors shall participate in the end-of-warranty-period conference, typically scheduled close to one year after the Substantial Completion date.

37. Date of Completion and Liquidated Damages

37.1 The Contractor may make a written request to the Owner for an extension or reduction of time, if necessary. The request shall include the reasons the Contractor believes justifies the proposed completion date. The Owner may grant the revision of the contract completion date if the Work was delayed due to conditions beyond the control and the responsibility of the Contractor. The Contractor shall not conduct unauthorized accelerated work or file delay claims to recover alleged damages for unauthorized early completion.

37.2 The Contractor shall vigorously pursue the completion of the Work and notify the Owner of any factors that have, may, or will affect the approved Schedule of the Work. The Contractor may be found responsible for expenses of the Owner or Consultant if the Contractor fails to make notification of project delays.

37.3 The Project is planned to be done in an orderly fashion which allows for an iterative submittal review process, construction administration including minor changes in the Work and some bad weather. The Contractor shall not file delay claims to recover alleged damages on work the Consultant determines has followed the expected rate of progress.

**00 72 13
General Conditions**

- 37.4 The Consultant shall prepare the Certificate of Substantial Completion which, when signed by the Owner and the Contractor, documents the date of Substantial Completion of the Work or a designated portion of the Work. The Owner shall not consider the issuance of a Certificate of Occupancy by an outside authority a prerequisite for Substantial Completion if the Certificate of Occupancy cannot be obtained due to factors beyond the Contractor’s control.
- 37.5 Liquidated Damages may be deducted from the sum due to the Contractor for each calendar day that the Work remains uncompleted after the completion date specified in the Contract or an approved amended completion date. The dollar amount per day shall be calculated using the Schedule of Liquidated Damages table shown below.

If the original contract amount is:	The per day Liquidated Damages shall be:
Less than \$100,000	\$250
\$100,000 to less than \$2,000,000	\$750
\$2,000,000 to less than \$10,000,000	\$1,500
\$10,000,000 and greater	\$1,500 plus \$250 for each \$2,000,000 over \$10,000,000

38. Dispute Resolution

38.1 Mediation

- 38.1.1 A dispute between the parties which arises under this Contract which cannot be resolved through informal negotiation, shall be submitted to a neutral mediator jointly selected by the parties.
- 38.1.2 Either party may file suit before or during mediation if the party, in good faith, deems it to be necessary to avoid losing the right to sue due to a statute of limitations. If suit is filed before good faith mediation efforts are completed, the party filing suit shall agree to stay all proceedings in the lawsuit pending completion of the mediation process, provided such stay is without prejudice.
- 38.1.3 In any mediation between the Owner and the Consultant, the Owner has the right to consolidate related claims between Owner and Contractor.

38.2 Arbitration

- 38.2.1 If the dispute is not resolved through mediation, the dispute shall be settled by arbitration. The arbitration shall be conducted before a panel of three arbitrators. Each party shall select one arbitrator; the third arbitrator shall be appointed by the arbitrators selected by the parties. The arbitration shall be conducted in accordance with the Maine Uniform Arbitration Act (MUAA), except as otherwise provided in this section.
- 38.2.2 The decision of the arbitrators shall be final and binding upon all parties. The decision may be entered in court as provided in the MUAA.
- 38.2.3 The costs of the arbitration, including the arbitrators’ fees shall be borne equally by the parties to the arbitration, unless the arbitrator orders otherwise.

00 72 13
General Conditions

38.2.4 In any arbitration between the Owner and the Consultant, the Owner has the right to consolidate related claims between Owner and Contractor.

00 73 46
Wage Determination Schedule

PART 1- GENERAL

1.1 Related Documents

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

1.2 Summary

- A. This Section includes the wage determination requirements for Contractors as issued by the State of Maine Department of Labor Bureau of Labor Standards or the United States Department of Labor.

1.3 Requirements

- A. Conform to the wage determination schedule for this project which is shown on the following page.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

**THIS DOCUMENT MUST BE CLEARLY POSTED AT THE PERTAINING STATE FUNDED PREVAILING WAGE
CONSTRUCTION SITE**

**State of Maine
Department of Labor
Bureau of Labor Standards
Augusta, Maine 04333-0045
Telephone (207) 623-7906**

Wage Determination - In accordance with 26 MRS §1301 et. seq., this is a determination by the Bureau of Labor Standards, of the fair minimum wage rate to be paid laborers and workers employed on the below title project.

Title of Project -----East Campus Energy Upgrades-Boiler Replacements

Location of Project – Augusta, Kennebec County

**2019 Fair Minimum Wage Rates
Building 2 Kennebec County
(other than 1 or 2 family homes)**

<u>Occupation Title</u>	<u>Minimum Wage</u>	<u>Minimum Benefit</u>	<u>Total</u>	<u>Occupation Title</u>	<u>Minimum Wage</u>	<u>Minimum Benefit</u>	<u>Total</u>
Asbestos/Lead Removal Worker	\$13.25	\$0.82	\$14.07	Ironworker - Structural	\$22.50	\$3.00	\$25.50
Backhoe Loader Operator	\$22.00	\$5.08	\$27.08	Laborers (Helpers & Tenders)	\$16.00	\$1.04	\$17.04
Boilermaker	\$24.00	\$9.00	\$33.00	Laborer - Skilled	\$18.05	\$2.79	\$20.84
Bricklayer	\$24.25	\$2.04	\$26.29	Loader Operator - Front-End	\$19.00	\$3.00	\$22.00
Bulldozer Operator	\$20.00	\$3.71	\$23.71	Mechanic- Maintenance	\$25.00	\$3.94	\$28.94
Carpenter	\$21.50	\$3.79	\$25.29	Mechanic- Refrigeration	\$26.00	\$5.16	\$31.16
Carpenter - Acoustical	\$19.50	\$2.03	\$21.53	Millwright	\$29.47	\$10.77	\$40.24
Carpenter - Rough	\$20.00	\$1.03	\$21.03	Oil/Fuel Burner Serv& Installer	\$23.00	\$3.51	\$26.51
Cement Mason/Finisher	\$19.50	\$2.11	\$21.61	Painter	\$16.50	\$0.00	\$16.50
Communication Equip Installer	\$22.20	\$3.67	\$25.87	Pipe/Steam/Sprinkler Fitter	\$25.25	\$5.95	\$31.20
Concrete Mixing Plant Operator	\$22.11	\$4.92	\$27.03	Plumber (Licensed)	\$25.00	\$4.04	\$29.04
Crane Operator =>15 Tons)	\$28.00	\$8.45	\$36.45	Plumber Helper/Trainee	\$21.00	\$3.37	\$24.37
Dry-Wall Applicator	\$22.00	\$0.00	\$22.00	Propane/Natural gas serv/inst	\$26.00	\$4.03	\$30.03
Dry-Wall Taper & Finisher	\$22.91	\$1.08	\$23.99	Pump Installer	\$16.13	\$3.14	\$19.27
Electrician - Licensed	\$27.00	\$4.53	\$31.53	Rigger	\$22.25	\$6.60	\$28.85
Electrician Helper/Cable Puller	\$17.00	\$1.24	\$18.24	Roofer	\$15.00	\$2.79	\$17.79
Excavator Operator	\$20.50	\$2.91	\$23.41	Sheet Metal Worker	\$19.52	\$3.12	\$22.64
Fence Setter	\$15.00	\$2.00	\$17.00	Sider	\$16.75	\$1.38	\$18.13
Flagger	\$13.00	\$0.00	\$13.00	Stone Mason	\$21.00	\$0.95	\$21.95
Floor Layer	\$20.00	\$3.06	\$23.06	Truck Driver - Light	\$17.00	\$1.17	\$18.17
Glazier	\$17.25	\$0.89	\$18.14	Truck Driver - Medium	\$19.00	\$3.37	\$22.37
HVAC	\$24.88	\$2.71	\$27.59	Truck Driver - Heavy	\$17.00	\$1.09	\$18.09
Insulation Installer	\$20.25	\$2.88	\$23.13	Truck Driver - Tractor Trailer	\$17.15	\$1.08	\$18.23
Ironworker - Reinforcing	\$16.00	\$2.79	\$18.79	Truck Driver - Mixer (Cement)	\$17.88	\$3.15	\$21.03

The Laborer classifications include a wide range of work duties. Therefore, if any specific occupation to be employed on this project is not listed in this determination, call the Bureau of Labor Standards at the above number for further clarification.

Welders are classified in the trade to which the welding is incidental.

Apprentices - The minimum wage rate for registered apprentices are those set forth in the standards and policies of the Maine State Apprenticeship and Training Council for approved apprenticeship programs.

Posting of Schedule - Posting of this schedule is required in accordance with 26 MRS §1301 et. seq., by any contractor holding a State contract for construction valued at \$50,000 or more and any subcontractors to such a contractor.

Appeal - Any person affected by the determination of these rates may appeal to the Commissioner of Labor by filing a written notice with the Commissioner stating the specific grounds of the objection within ten (10) days from the filing of these rates with the Secretary of State.

Determination No: B2-079-2019

A true copy

Filing Date: July 1, 2019

Attest:

Scott R. Cotnoir

**Scott R. Cotnoir
Wage & Hour Director
Bureau of Labor Standards**

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Rotor: Random-wound, squirrel cage.
- E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating.
- G. Insulation: Class F.
- H. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- B. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.

- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Equipment supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers 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 trapeze hangers.
 - 2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural-Steel 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, Section IX.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-Line, Inc.
 - b. Flex-Strut Inc.
 - c. Unistrut Corporation
 - d. Tyco International, Ltd.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. ERICO International Corporation.
 2. Piping Technology & Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulation for HVAC piping systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties.
 - 6. Detail application of field-applied jackets.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material test reports.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- D. GLASS FIBER
 1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Knauf Insulation.
 - b. Certainteed Corporation.
 - c. Johns Manville.

- d. Owens Corning.
2. Insulation: ASTM C547; rigid molded, noncombustible.
 - a. 'K' ('Ksi') value: ASTM C177, 0.24 Btu-in/(hr-sq.ft- degrees F) at 75 degrees F (0.035 W/m-K at 24 degrees C).
 - b. Maximum service temperature: 850 degrees F (454 degrees C).
 - c. Maximum moisture absorption: 0.2 percent by volume.
3. Vapor Barrier Jacket:
 - a. ASTM C1136, White kraft paper with glass fiber yarn, bonded to aluminized film.
 - b. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.

2.2 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.3 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. Aluminum Jacket: ASTM B209, ASTM B209M.
 1. Thickness: 0.016 inch (0.40 mm) sheet.
 2. Finish: Corrugated or embossed.
 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
 5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
- C. Shields:
 1. Carpenter and Paterson Figure 265GS, or equal.
 2. Galvanized or electro-galvanized steel, minimum 12 inch length, minimum 120-degree arc, minimum 18 ga.
 3. Provide contact adhesive to glue shields to the insulation.
- D. Saddles:
 1. Factory fabricated of curved carbon steel plate, of same overall thickness and contour as adjoining insulation. Sides designed for welding to pipe. Center support plate for pipe sizes 12 inches (300 mm) and larger.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.
- K. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- N. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.

3.3 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement.

- Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.7 FINISHES

- A. Do not field paint aluminum or stainless steel jackets.

1.1 FIELD INSPECTION

- A. Visually inspect to ensure that materials used conform to specifications. Inspect installations progressively for compliance with requirements.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Underground piping.
 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING JACKET SCHEDULE

- A. Apply aluminum jacket to insulated pipe that is within 6 feet of the finished floor or catwalk. The main steam 8 inch header does not require aluminum jacket.

3.10 INDOOR PIPING INSULATION SCHEDULE

SERVICE	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS AT THE FOLLOWING PIPE DIAMETERS					
			<1 inch	1 inch to <1.5 inches	1.5 inches to <4 inches	4 inches to <8 inches	8 inches or Greater	
Heating Systems (Steam, Steam Condensate, boiler blow-down)								
Fluid Design Operating Temperature Range								
Steam (251 degrees F to 350 deg. F)	Glass Fiber	No	3 inches	4 inches	4.5 inches	4.5 inches	4.5 inches	4.5 inches
Condensate and Boiler Blowdown (201 degrees F to 250 deg. F)	Glass Fiber	No	2.5 inches	2.5 inches	2.5 inches	3 inches	3 inches	3 inches

END OF SECTION 230719

SECTION 231113 - FACILITY FUEL-OIL PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fuel-oil pipes, tubes, and fittings.
 - 2. Double-containment piping and fittings.
 - 3. Piping specialties.
 - 4. Joining materials.
 - 5. Specialty valves.
 - 6. Leak detection and monitoring system.
 - 7. Labels and identification.

1.3 DEFINITIONS

- A. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and dimensions of individual components and profiles.
 - 2. Include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. For valves, include pressure rating, capacity, settings, and electrical connection data of selected models.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-oil equipment and accessories to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.8 FIELD CONDITIONS

- A. Interruption of Existing Fuel-Oil Service: Do not interrupt fuel-oil service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fuel-oil supply according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of fuel-oil service.
 - 2. Do not proceed with interruption of fuel-oil service without Owner's written permission.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of flexible, double-containment piping and related equipment that fail in materials or workmanship within specified warranty period.
 - 1. Failures due to defective materials or workmanship for materials including piping, dispenser sumps, water-tight sump entry boots, terminations, and other end fittings.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- 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. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.
- C. Fuel-Oil Valves: Comply with UL 842 and have service mark initials "WOG" permanently marked on valve body.

2.2 PERFORMANCE REQUIREMENTS

- A. Maximum Operating-Pressure Ratings: 150-psig fuel-oil supply pressure in fuel oil supply line.

2.3 FUEL-OIL PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, 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 A234/A234M, for butt and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.
 - e. Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.

2.4 PIPING SPECIALTIES

- A. Metallic Flexible Connectors:
 - 1. Listed and labeled for aboveground and underground applications by an NRTL acceptable to authorities having jurisdiction.
 - 2. Stainless-steel bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
 - 3. Minimum Operating Pressure: 150 psig.
 - 4. End Connections: Socket, flanged, or threaded end to match connected piping.
 - 5. Maximum Length: 30 inches

6. Swivel end, 50-psig maximum operating pressure.
 7. Factory-furnished anode for connection to cathodic protection.
- B. Nonmetallic Flexible Connectors:
1. Listed and labeled for underground applications by an NRTL acceptable to authorities having jurisdiction.
 2. PTFE bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
 3. Minimum Operating Pressure: 150 psig.
 4. End Connections: Socket, flanged, or threaded end to match connected piping.
 5. Maximum Length: 30 inches
 6. Swivel end, 50-psig maximum operating pressure.
 7. Factory-furnished anode.
- C. Y-Pattern Strainers:
1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 3. Strainer Screen: 80-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- D. Basket Strainers:
1. Body: ASTM A126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 3. Strainer Screen: 80-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- E. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
 2. End Connections: Grooved ends.
 3. Strainer Screen: 80-mesh startup strainer and perforated stainless-steel basket with 57 percent free area.
 4. CWP Rating: 750 psig.
- F. Manual Air Vents:
1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Screwdriver or thumbscrew.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/8.
 6. CWP Rating: 150 psig.

7. Maximum Operating Temperature: 225 deg F.

2.5 JOINING MATERIALS

- A. Joint Compound and Tape for Threaded Joints: Suitable for fuel oil.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.6 SPECIALTY VALVES

- A. Pressure Relief Valves:
 1. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
 2. Body: Brass, bronze, or cast steel.
 3. Springs: Stainless steel, interchangeable.
 4. Seat and Seal: Nitrile rubber.
 5. Orifice: Stainless steel, interchangeable.
 6. Factory-Applied Finish: Baked enamel.
 7. Maximum Inlet Pressure: 150 psig.
 8. Relief Pressure Setting: 100 psig.
- B. Oil Safety Valves:
 1. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
 2. Body: Brass, bronze, or cast steel.
 3. Springs: Stainless steel.
 4. Seat and Diaphragm: Nitrile rubber.
 5. Orifice: Stainless steel, interchangeable.
 6. Factory-Applied Finish: Baked enamel.
 7. Manual override port.
 8. Maximum Inlet Pressure: 150 psig.
- C. Emergency Shutoff Valves:
 1. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
 2. Single or Double poppet valve.
 3. Body: ASTM A126, cast iron.
 4. Disk: FPM.
 5. Poppet Spring: Stainless steel.
 6. Stem: Plated brass.

7. O-Ring: FPM.
8. Packing Nut: PTFE-coated brass.
9. Fusible link to close valve at 165 deg F.
10. Thermal relief to vent line pressure buildup due to fire.
11. Air test port.
12. Maximum Operating Pressure: 0.5 psig.

2.7 LEAK-DETECTION AND MONITORING SYSTEM

A. Cable and Sensor System: Comply with UL 1238.

1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Franklin Fueling Systems.
2. Calibrated leak-detection and monitoring system with probes and other sensors and remote alarm panel for fuel-oil piping.
3. Include fittings and devices required for testing.

2.8 LABELS AND IDENTIFICATION

- ### A. Detectable Warning Tape: Acid- and alkali-resistant PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils 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 deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of fuel-oil piping.
- B. Examine installation of fuel-burning equipment and fuel-handling and storage equipment to verify actual locations of piping connections before installing fuel-oil piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Close equipment shutoff valves before turning off fuel oil to premises or piping section.
- E. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.2 INDOOR PIPING INSTALLATION

- A. 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.
- B. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings at a height that allows sufficient space for ceiling panel removal.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Comply with requirements for equipment specifications for roughing-in requirements.
- I. Prohibited Locations:
 - 1. Do not install fuel-oil piping in or through HVAC ducts and plenums, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - 2. Do not install fuel-oil piping in solid walls or partitions.
- J. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- K. Connect branch piping from top or side of horizontal piping.
- L. Install unions in pipes NPS 2 and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.
- M. Do not use fuel-oil piping as grounding electrode.
- N. Install sleeves and sleeve seals for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

3.3 VALVE INSTALLATION

- A. Install manual fuel-oil shutoff valves on branch connections to fuel-oil appliance.

- B. Install valves in accessible locations.
- C. Install oil safety valves at inlet of each oil-fired appliance.
- D. Install pressure relief valves in distribution piping between the supply and return lines.
- E. Install one-piece, bronze ball valve with hose end connection at low points in fuel-oil piping. Comply with requirements in Section 230523.12 "Ball Valves for HVAC Piping."
- F. Install manual air vents at high points in fuel-oil piping.
- G. Install emergency shutoff valves at dispensers.

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: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. 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: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Bevel plain ends of steel pipe.
 - 2. 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 Tubing" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.
- G. Flared Joints: Comply with SAE J513. Tighten finger tight then use wrench according to fitting manufacturer's written instructions. Do not overtighten.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1-1/4 and Smaller: Maximum span, 84 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
 - 5. NPS 3: Maximum span, 12 feet; minimum rod size, 1/2 inch.
 - 6. NPS 4: Maximum span, 13 feet; minimum rod size, 5/8 inch.
- C. Support vertical steel pipe at each floor and at spacing not greater than 15 feet.
- D. Install hangers for horizontal, drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4 and Smaller: Maximum span, 60 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/4: Maximum span, 84 inches; minimum rod size, 3/8 inch.
 - 4. NPS 1-1/2 and NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 1/2 inch.
 - 6. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 7. NPS 4: Maximum span, 11 feet; minimum rod size, 5/8 inch.
- E. Support vertical copper tube at each floor and at spacing not greater than 10 feet.

3.6 LEAK-DETECTION AND MONITORING SYSTEM INSTALLATION

- A. Install leak-detection and monitoring system. Install alarm panel inside building where indicated.

3.7 CONNECTIONS

- A. Where installing piping adjacent to equipment, allow space for service and maintenance.
- B. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
- C. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
- D. Connect piping to equipment with shutoff valve and union. Install union between valve and equipment.
- E. Install flexible piping connectors at final connection to burners or oil-fired appliances.

3.8 LABELING AND IDENTIFYING

- A. Nameplates, pipe identification, valve tags, and signs are specified in Section 230553 "Identification for HVAC Piping and Equipment."
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.
 - 1. Text: In addition to identifying unit, distinguish between multiple units; inform operator of operational requirements; indicate safety and emergency precautions; and warn of hazards and improper operations.

3.9 FIELD QUALITY CONTROL

- A. Pressure Test Piping: Minimum hydrostatic or pneumatic test-pressures measured at highest point in system:
 - 1. Fuel-Oil Distribution Piping: Minimum 5 psig for minimum 30 minutes.
 - 2. Isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 10 psig.
- B. Inspect and test fuel-oil piping according to NFPA 31, "Tests of Piping" Paragraph; and according to requirements of authorities having jurisdiction.
- C. Test leak-detection and monitoring system for accuracy by manually operating sensors and checking against alarm panel indication.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Bleed air from fuel-oil piping using manual air vents.
- F. Fuel-oil piping and equipment will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

3.10 INDOOR PIPING SCHEDULE

- A. Aboveground fuel-oil piping shall be one of the following:
 - 1. NPS 1/2 and Smaller: Annealed-temper copper pipe, wrought copper fittings, and brazed or flared joints.
 - 2. NPS 5/8 to NPS 2: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.

3.11 SHUTOFF VALVE SCHEDULE

- A. Valves for aboveground distribution piping NPS 2 and smaller shall be the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- B. Valves in branch piping for single appliance shall be the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231113

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Manual gas shutoff valves.
 - 5. Motorized gas valves.
 - 6. Pressure regulators.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated, stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Dielectric fittings.
- 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- C. Qualification Data: For qualified professional engineer.
- D. Welding certificates.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For motorized gas valves and pressure regulators to include in emergency, operation, and maintenance manuals.

1.7 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.
 2. Do not proceed with interruption of natural-gas service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 2. Service Regulators: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: More than 0.5 psig but not more than 2 psig.

2.2 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, 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 A234/A234M 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. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
1. Tubing: ASTM A240/A240M, corrugated, Series 300 stainless steel.
 2. Coating: PE with flame retardant.

- a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
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.

2.3 PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
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 and smaller.
 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig.
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; Conbraco Industries, Inc.
 - c. BrassCraft Manufacturing Co.; a Masco Company
 - d. Lyall, R.W. & Company, Inc.
 - e. Perfection Corporation
 2. Body: Bronze, complying with ASTM B584.
 3. Ball: Chrome-plated brass.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Separate packnut with adjustable-stem packing threaded ends.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; Conbraco Industries, Inc.
 - c. BrassCraft Manufacturing Co.; a Masco Company
 - d. Lyall, R.W. & Company, Inc.
 - e. Perfection Corporation

2. Body: Bronze, complying with ASTM B584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Apollo Valves; Conbraco Industries, Inc.
 - c. BrassCraft Manufacturing Co.; a Masco Company
 - d. Lyall, R.W. & Company, Inc.
 - e. Perfection Corporation
2. Body: Bronze, complying with ASTM B584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.6 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.

1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dungs, Karl, Inc
 - b. Eaton
 - c. Eclipse Innovative Thermal Technologies
 - d. Honeywell Building Solutions; Honeywell International, Inc.
 - e. Johnson Controls.

2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. Normally closed.
6. Visual position indicator.
7. Electrical operator for actuation by appliance automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.

1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dungs, Karl, Inc
 - b. Eclipse Innovative Thermal Technologies
 - c. Goyen Valve Corp.
 - d. Magnatrol Valve Corporation
 - e. Parker Hannifin Corporation
 - f. Watts; a Watts Water Technologies company
2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

2.7 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton
 - b. Harper Wyman Co
 - c. Maxitrol Company
 - d. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig.

2.8 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 wide and 4 mils 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 deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 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 for 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 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. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.

3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 5. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage downstream from each line regulator.
- W. Install sleeve seals for piping penetrations of concrete walls and slabs.
- 3.4 VALVE INSTALLATION
- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
 - B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- 3.5 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. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. 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.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

C. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2 and NPS 5/8: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and NPS 7/8: Maximum span, 84 inches; minimum rod size, 3/8 inch.
4. NPS 1: Maximum span, 96 inches; minimum rod size, 3/8 inch.

- D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.7 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 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.

3.8 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.9 PAINTING

- A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.
- B. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (gloss).
 - d. Color: Yellow.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

- A. Aboveground, distribution piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with steel welding fittings and welded joints (required for greater than 2 inch diameter).

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. 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, full-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.

END OF SECTION 231123

SECTION 231126 - FACILITY LIQUEFIED-PETROLEUM GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.

1.3 DEFINITIONS

- A. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- D. LPG: Liquefied-petroleum gas.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. For Piping Containing Only Vapor:
 - a. Piping and Valves: 125 psig unless otherwise indicated.
- B. LPG System Pressure within Buildings: One pressure range. More than 0.5 psig but not more than 2 psig.

- C. LPG System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig and is reduced to secondary pressure of 0.5 psig or less.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
- B. Shop Drawings: For facility LPG 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which LPG piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Field quality-control reports.

1.7 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing LPG piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store pipes and tubes with protective PE coating to avoid damaging coating and protect from direct sunlight.

1.9 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing LPG Service: Do not interrupt LPG service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of LPG supply according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of LPG service.
 - 2. Do not proceed with interruption of LPG service without Owner's written permission.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, Schedules 40 and 80, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A234/A234M 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. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground, and stainless steel underground.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
 - 1. ASTM A240/A240M, corrugated, Series 300 stainless steel.
 - 2. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
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.
- C. Annealed-Temper Copper Tube: Comply with ASTM B88, Type K.
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
 2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.
 3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.

2.2 PIPING SPECIALTIES

A. Flexible Piping Joints:

1. Approved for LPG service.
2. Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
3. Minimum working pressure of 250 psig and 250 deg F operating temperature.
4. Flanged- or threaded-end connections to match equipment connected and shall be capable of minimum 3/4-inch misalignment.
5. Maximum 36-inch length for liquid LPG lines.

B. 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.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

C. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Basket Strainers:

1. Body: ASTM A126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

E. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 60-mesh startup strainer and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

- F. 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.

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for LPG.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M.

2.4 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. Metallic Valves, NPS 2 and Smaller for Liquid Service: Comply with ASME B16.33 and UL 842.
1. CWP Rating: 250 psig.

2. Threaded Ends: Comply with ASME B1.20.1.
 3. Socket ends for brazed joints.
 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 by CSA or agency acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 6. Valves 1-1/4 inch and larger shall be suitable for LPG service, with "WOG" indicated on valve body.
- C. General Requirements for Metallic Valves, NPS 2 and Smaller for Vapor Service: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
 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 and smaller.
 6. Service Mark: Valves 1-1/4 inch to NPS 2 shall have initials "WOG" permanently marked on valve body.
- D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton
 - b. Harper Wyman Co
 - c. Maxitrol Company
 - d. SCP, Inc.
 2. Body: Bronze, complying with ASTM B584.
 3. Ball: Chrome-plated brass.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Separate packnut with adjustable-stem packing threaded ends.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for LPG service with "WOG" indicated on valve body.
- E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Eaton
 - b. Harper Wyman Co
 - c. Maxitrol Company
 - d. SCP, Inc.
2. Body: Bronze, complying with ASTM B584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for LPG service with "WOG" indicated on valve body.
- F. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton
 - b. Harper Wyman Co
 - c. Maxitrol Company
 - d. SCP, Inc.
 2. Body: Bronze, complying with ASTM B584.
 3. Ball: Chrome-plated bronze
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for LPG service with "WOG" indicated on valve body.

2.5 MOTORIZED GAS VALVES

- A. Automatic Gas Valves: Comply with ANSI Z21.21.
1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dungs, Karl, Inc
 - b. Eaton
 - c. Eclipse Innovative Thermal Technologies

- d. Honeywell Building Solutions; Honeywell International, Inc.
- e. Johnson Controls.

- 2. Body: Brass or aluminum.
- 3. Seats and Disc: Nitrile rubber.
- 4. Springs and Valve Trim: Stainless steel.
- 5. Normally closed.
- 6. Visual position indicator.
- 7. Electrical operator for actuation by appliance automatic shutoff device.

- A. Electrically Operated Valves: Comply with UL 429.
 - 1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dungs, Karl, Inc
 - b. Eclipse Innovative Thermal Technologies
 - c. Goyen Valve Corp.
 - d. Magnatrol Valve Corporation
 - e. Parker Hannifin Corporation
 - f. Watts; a Watts Water Technologies company

 - 2. Pilot operated.
 - 3. Body: Brass or aluminum.
 - 4. Seats and Disc: Nitrile rubber.
 - 5. Springs and Valve Trim: Stainless steel.
 - 6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
 - 7. NEMA ICS 6, Type 4, coil enclosure.
 - 8. Normally closed.
 - 9. Visual position indicator.

2.6 PRESSURE REGULATORS

- A. General Requirements:
 - 1. Single stage and suitable for LPG.
 - 2. Steel jacket and corrosion-resistant components.
 - 3. Elevation compensator.
 - 4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

- A. Appliance Pressure Regulators: Comply with ANSI Z21.18.
 - 1. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Eaton
 - b. Harper Wyman Co
 - c. Maxitrol Company

- d. SCP, Inc.
 - 2. Body and Diaphragm Case: Die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber.
 - 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 - 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
 - 9. Maximum Inlet Pressure: 5 psig.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for LPG piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off LPG to premises or piping section.
- B. Inspect LPG piping according to NFPA 58 and NFPA 54 to determine that LPG utilization devices are turned off in piping section affected.
- C. Comply with NFPA 58 and NFPA 54 requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of LPG piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were 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 for 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 LPG 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 readily 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 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. Concealed Location Installations: Except as specified below, install concealed LPG piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: LPG piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install LPG piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 - 3. In Floor Channels: Install LPG piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

- a. Exception: Tubing passing through partitions or walls does not require striker barriers.
5. Prohibited Locations:
- a. Do not install LPG piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install LPG piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use LPG piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage downstream from each line regulator.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors.
- 3.4 VALVE INSTALLATION
- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, or copper connector.
 - B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- 3.5 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 ID 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. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Ch. 22, "Pipe and Tube."

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for LPG service. Install gasket concentrically positioned.

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.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for steel piping, with maximum spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping within 12 inches of each fitting.

D. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install LPG 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 of each gas-fired appliances 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.

3.8 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.9 PAINTING

- A. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (gloss).
 - d. Color: Yellow.
- B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge LPG according to NFPA 58 and NFPA 54 and requirements of authorities having jurisdiction.
- C. LPG piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be the following:
 - 1. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be the following:
 - 1. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.

3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be the following:
 - 1. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be the following:

1. Schedule 40, steel pipe with malleable-iron fittings and threaded joints.

3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe NPS 2 and smaller at service meter shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.

- B. Distribution piping valves for pipe NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-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, full-port, bronze ball valves with bronze trim.

END OF SECTION 231126

SECTION 231213 - FACILITY FUEL-OIL PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RERERENCE STANDARDS

- A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 1. NFPA 30 – Flammable and Combustible Liquids Code.
 2. NFPA 31 – Installation of Oil Burning Equipment.
 3. NFPA 37 – Installation and Use of Stationary Combustion Engines and Turbines.
 4. NFPA 70 – National Electric Code.
 5. NFPA 99 – Standard for Healthcare Facilities.
 6. NFPA 110 – Standard for Emergency and Standby Power Systems.
 7. UL 508A – The UL Safety Standard for Industrial Control Equipment.
 8. IFC 2012 – Chapter 57 Flammable and Combustible Liquids.
 9. IFC 2012 – Chapter 6 Building Services and Systems.
 10. PEI / RP 100 – Recommended Practices for Installation of USTs.
 11. PEI / RP 200 – Recommended Practices for Installation of ASTs.
 12. ASTM A36 – Standard Specification for Carbon Structural Steel.
 13. ASTM A53 – Specification for Pipe, Steel, Black/Hot Dipped, Zinc Coated, Welded, SS.
 14. All applicable state and local requirements.

1.3 SUMMARY

- A. Section Includes:
 1. Duplex fuel-oil pumps.
 2. Fuel oil controls.
 3. Fuel oil leak detection.
 4. Fuel oil tank level indication and high level alarm.

1.4 DEFINITIONS

- A. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

- B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and dimensions of individual components and profiles.
 - 2. Include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Shop Drawings:
 - a. The drawing(s) need to indicate system layout with the location and elevation of the fuel oil pumping system and related equipment.
 - b. The Drawings shall also indicate conduit requirements and routing for electrical power and controls with point to point diagram.
 - 4. Product Data:
 - a. Provide catalog data on all controls, pumps, associated valves, piping, tanks and other equipment including material of construction, dimensional data and ratings.
 - b. Provide manufacturer's products installation instructions and calibration charts.
 - 5. Record Documents:
 - a. Record documents shall include as built Drawings indicating the location of fuel oil pumping system and system components.
 - b. Fuel oil system installation, start-up and commissioning check-lists and other applicable documentation shall be provided.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-oil pumps and fuel-oil maintenance systems to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer: Equipment, controls and all fuel oil specialty devices shall be provided by a single supplier to ensure a complete functional and coordinated system with single source responsibility. Supplier shall give guidance to equipment and device installation and shall complete all programming, commissioning and owner training. The supplier shall be a firm with (five) 5 years of documented experience in the installation of integrated emergency fuel systems.
- B. Installer: Company specializing in performing the work of this Section with minimum three (3) years documented experience. Bidding installation contractor shall hold license(s) as required by the AHJ.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Maximum Operating-Pressure Ratings: 3-psig fuel-oil supply pressure at oil-fired appliances.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design restraint and anchors for fuel-oil pumps, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- 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.
- D. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.

2.2 DUPLEX FUEL-OIL TRANSFER PUMP SETS

- A. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Critical Fuel Systems, a division of BFS Industries, LLC.
 - 2. Safesite by Core Engineered Solutions.
- B. Description: Comply with HI 3.1-3.5.
 - 1. Type: Positive-displacement, rotary type.
 - 2. Housing: Cast-iron foot mounted.
 - 3. Bearings: Bronze, self-lubricating.
 - 4. Shaft: Polished steel.
 - 5. Seals: Mechanical.
 - 6. Base: Steel.
 - 7. Pressure Relief: Built in.
 - 8. Discharge Check Valve: Built in

9. Discharge pressure gauges.
 10. Differential pressure gauge.
 11. Ball valves.
 12. Duplex, basket type strainers with corrosion-resistant-metal-screen baskets.
- C. Drive: Gear reducer, or direct close coupled.
- D. Controls:
1. Microprocessor-based control panel with 6-inch touchscreen housed in a NEMA 4X enclosure.
 2. Alternate pumps to equalize run time.
 3. Alarm motor failure.
 4. Manual reset dry-run protection.
 5. Stop pumps if fuel level falls below pump suction.
 6. De-energize and sound alarm for pump, locked-rotor condition.
 7. Alarm light and annunciator.
 8. Sound alarm for open circuit and for high and low voltage.
 9. Lights shall indicate normal power on, run, and off conditions.
 10. Variable frequency drive for each pump motor, with overload protection.
 11. Leak detection for pump drip pan.
 12. Leak detection for fuel tank berm.
 13. Tank level monitoring and high-level alarm for two fuel tanks.
 14. Flow switch.
 15. Pressure/vacuum sensor.
 16. Interface automatic control system with existing building BACnet Honeywell system. Control and indicate the following:
 - a. Start/stop pump set when required by schedule, fuel-fired appliance operation, day tank level control, or weather conditions.
 - b. Operating status.
 - c. Alarm off-normal status.
- E. Piping Furnished with Pumps: The Duplex Pump Skid shall be factory assembled and tested. All pipe shall be Schedule 40 ASTM A-53 Grade A with ANSI B16.3 Class 150 malleable iron threaded fittings. The assembly shall be factory mounted on a pump skid base and support rack. The pump skid base and support rack shall be continuously welded steel plate with 3" steel side rails with a 1/2" containment basin drain plug. The pump skid base and support rack shall be powder coated. The pump skid base and support rack shall be hydrostatically tested at the factory.
1. Isolation Valves: The Duplex Pump Skid shall be assembled with four isolation valves, one on both the suction and discharge of each pump. The isolation valves shall be full-port ball valves to provide full flow and positive shutoff.
 2. Check Valves: The Duplex Pump Skid shall be assembled with a check valve on the discharge of each pump. The check valves shall be swing style and mounted horizontally. Spring style check valves will not be permitted.
 3. Fuel Oil Strainer: The Duplex Pump Skid shall be assembled with a duplex strainer in the incoming fuel line. The duplex strainer shall use 40-mesh baskets. The duplex strainer shall have a differential pressure gauge installed with a 0-10PSIG alarm set point.

4. Pressure Relief Valve: The Duplex Pump Skid shall be assembled with pressure relief valves that are sized to relieve the full discharge of the pump. The pressure relief valves shall be field piped in accordance with NFPA 30. Internal pump pressure relief valves will not be accepted as a sole means of overpressure protection. The pressure relief valves shall be field adjustable with a metal-on-metal lapped seating and stainless steel springs.
5. Flow Switch: The Duplex Pump Skid shall be assembled with a flow sensing switch on the discharge of the pump. The flow switch shall activate the lag pump should the lead pump fail to provide or maintain flow. The flow switch shall be factory wired to the Integrated Control Panel.
6. Pumps: The Duplex Pump Skid shall be assembled with two positive displacement fuel oil pumps. The pumps shall be UL343. The pumps shall be rotary type with cast iron housing and self-adjusting mechanical carbon steel ring seals. Aluminum, brass or bronze pump housing will not be permitted. Packing gland, close-coupled, carbonator shaft or centrifugal pumps will not be permitted. The pumps shall have an internal pressure relief valve for overpressure protection.
7. The pumps shall be configured with two open drip proof, rigid base, NEMA frame motors. The pump and motor assemblies shall be factory assembled and mounted to the pump skid base and support rack with vibration isolation pads. Flexible connectors shall be installed on both the suction and discharge of each pump and motor assembly.
8. Leak Sensor and Level Transmitter: The leak detection and level monitoring shall be a standalone Automatic Tank Gauging system interfaced with the Fuel Oil Controller and Building Management System (BMS).
9. Factory Testing: The Duplex Pump Skid shall be factory tested prior to shipment. The factory testing shall include both pressure and vacuum testing for 24-hours. The pressure testing shall be the greater of either 100SIG or 1.5 times the normal operating pressure of the system with an allowable loss of 4SIG. The vacuum testing shall be 26inHG with an allowable loss of 1 in HG. The power, control logic and control wiring shall be tested through a functionality test of each of the devices. A certification of the factory testing along with a copy of the project specific wiring diagrams shall be placed in the Integrated Control Panel prior to shipment.

F. Capacities and Characteristics:

1. Number of Stages: 1.
2. Capacity (Each Pump): 300 gph.
3. Discharge Pressure: 100 psig.
4. Inlet and Outlet Size: 1" NPS.
5. Motor Speed: 1140 rpm.
6. Motor Horsepower (Each Pump): 1.
7. Electrical Characteristics (Pump Set):
 - a. Volts: 208.
 - b. Phase: Three.
 - c. Hertz: 60.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 TANK MONITORING SYSTEM

- A. Configuration: Electronic system includes high level, low level, leak indications, alarm panel, magnetostrictive tank gauging probe, discriminating leak sensor, Remote alarm and printer.
- B. Communication: The tank monitoring system shall be interfaced with the Fuel Oil Control panel and the Building Management System (BMS).
- C. Approvals: UL-listed, CUL-listed, CE-listed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for fuel-oil pumps to verify actual locations of pump connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off fuel oil to premises or piping section.
- B. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.3 FUEL-OIL PUMP INSTALLATION

- A. Transfer Pumps:
 - 1. Install pumps with access space for periodic maintenance including removal of motors, impellers, and accessories.
 - 2. Pump Skid Mounting:
 - a. Install pump skid per manufacturer's recommendations.
- B. Install mechanical leak-detector valves at pump discharge.
- C. Install suction piping with minimum fittings and change of direction.

- D. Install vacuum and pressure gage, upstream and downstream, respectively, at each pump to measure the differential pressure across the pump.

3.4 SYSTEM ACTIVATION

- A. Prior to activating the FOC system, perform the following procedure:
- B. Flush system piping with grade of fuel to be used by Owner to remove any debris and foreign matter in piping prior to filling tank for the first time.
- C. Service all system filters and screens and dispose of fuel in accordance with EPA and NFPA regulations after flushing.
- D. Open valves to correct position for system operation.
- E. The Installation Contractor shall be responsible for the review of, and compliance with local requirements for system inspection, reporting and registration, as well as administrative paperwork requirements.

3.5 ADJUSTING AND CLEANING

- A. Touch-up any abraded areas with the application of same coating used by the manufacturer. Manufacturer to include sufficient quantity of touch-up paint for this purpose.
- B. Repair or replace damaged components.

3.6 LABELING AND IDENTIFYING

- A. Install nameplates and signs on each fuel-oil pump.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
 - 1. Start fuel-oil transfer pumps to verify for proper operation of pump, and check for leaks.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Fuel-oil pumps will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fuel-oil pumps.

END OF SECTION 231213

SECTION 232218 – STEAM AND CONDENSATE HEATING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Steam traps.
- B. Steam air vents.
- C. Pressure reducing valves.
- D. Steam safety valves.
- E. Strainers.

1.2 RELATED SECTIONS

- A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”
- B. Division 23 Section “Steam and Condensate Piping.”

1.3 REFERENCES

- A. ASME - Boiler and Pressure Vessel Codes, SEC 8-D - Rules for Construction of Pressure Vessels.
- B. ASME B31.9 - Building Services Piping.
- C. ASTM A105 - Forgings, Carbon Steel, for Piping Components.
- D. ASTM A126 - Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
- E. ASTM A216 - Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
- F. ASTM A395 - Ferric Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

1.4 SYSTEM DESCRIPTION

- A. Follow these guidelines unless otherwise indicated.
- B. Use Float and Thermostatic Traps for:
 - 1. Main headers.
 - 2. Branch lines.
- C. Use Inverted Bucket Steam Traps for:
 - 1. Main headers.

2. Branch lines.

1.5 PERFORMANCE REQUIREMENTS

- A. Steam Traps:
 1. Select to handle minimum of 2 times maximum condensate load of apparatus served.
 2. Where 2 traps are indicated on a coil or other equipment, select each for the full equipment condensate load.
 3. Pressure Differentials (unless otherwise indicated):
 - a. Low Pressure Steam (150 psi maximum): 40 psi.

1.6 SUBMITTALS

- A. Product Data:
 1. Provide for manufactured products and assemblies required for this project.
 2. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each specialty.
 4. Include electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Indicate application, selection, and hookup configuration. Include pipe and accessory elevations.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01 Section "Operation and Maintenance Data."
- B. Operation and Maintenance Data: Include installation instructions, servicing requirements, and recommended spare parts lists.

1.8 QUALITY ASSURANCE

- A. Perform Work in accordance with State and Municipality standards for installation of boilers and pressure vessels.
- B. Maintain 1 copy of each standards document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

1.10 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of steam and steam condensate piping and specialties.
- B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the

purpose indicated.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01 Section "Product Requirements."
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.12 EXTRA MATERIALS

- A. Furnish under provisions of Division 01 Section "Closeout Procedures."
- B. Provide 2 service kits for each size and type of steam trap.

PART 2 - PRODUCTS

2.1 INVERTED BUCKET TRAPS

- A. Manufacturers:
 - 1. Spirax Sarco.
 - 2. Armstrong International.
 - 3. Barnes and Jones.
 - 4. Hoffman Specialty – a division of Xylem.
 - 5. Watson McDaniel.
- B. Trap:
 - 1. Construction: ASTM A126 body of cast iron or stainless steel, with bolted cover, brass or stainless steel bucket, stainless steel seats and plungers, and stainless steel lever mechanism with knife edge operating surfaces.
- C. Rating: 250 psig shell design pressure up to 450 degrees F. Select operating differential pressure and orifice size as appropriate for system pressure.
- D. Features: Access to internal parts without disturbing piping, (cast iron bodies only) bottom drain plugs.
- E. Accessories: Integral bimetal air vent for quick startup, set to close at approximately 200 degrees F.

2.2 FLOAT AND THERMOSTATIC TRAPS

- A. Manufacturers:
1. Spirax Sarco.
 2. Armstrong International.
 3. Barnes and Jones.
 4. Hoffman Specialty – a division of Xylem.
 5. Watson McDaniel.
- B. Trap:
1. Construction: ASTM A126 cast iron or stainless steel body and bolted cover, stainless steel or bronze bellows type air vent, stainless steel float, stainless steel lever and valve assembly.
 2. Rating up to 450 degrees F:
 - a. Low Pressure Steam: 150 psig shell design pressure.
 3. Select operating differential pressure and orifice size as appropriate for system pressure.
 4. Features: Access to internal parts without disturbing piping, bottom drain plug.

2.3 STEAM AIR VENTS

- A. 125 psig WSP:
1. Manufacturers:
 - a. Spirax Sarco.
 - b. Armstrong International.
 - c. ITT Hoffman Specialty.
 2. Balanced Pressure Type: Model T202, cast brass body and cover; access to internal parts without disturbing piping; stainless steel bellows, stainless steel valve and seat.
- B. 225 psig WSP:
1. Manufacturers:
 - a. Spirax Sarco.
 - b. Armstrong International.
 - c. ITT Hoffman Specialty.
 2. Balanced Pressure Type: Series VS200, ASTM A126 cast iron body and cover; access to internal parts without disturbing piping; phosphor bronze bellows, stainless steel valve and seat.

2.4 STEAM VACUUM BREAKERS

- A. Manufacturers:
1. Spirax Sarco.
 2. Armstrong International.
 3. Hoffman Specialty.
 4. Watson McDaniel.
- B. Cast brass or stainless steel body and cover, stainless steel valve and seat; threaded inlet and outlet; access to inspect internal parts without disturbing piping; for 210 psig up to 500 degrees F; venting 4 CFM standard air at 6 in. Hg vacuum.

2.5 PRESSURE REDUCING VALVES

- A. Manufacturers:
 - 1. Spence.
 - 2. Armstrong International.
 - 3. Hoffman Specialty – a division of Xylem.
 - 4. Spirax Sarco.
 - 5. Watson McDaniel.

- B. Bronze or cast iron body, stainless or chrome steel valve spring, stem, and trim, phosphor bronze diaphragm, pilot operated, threaded up to 2 inches (50 mm), flanged over 2 inches (50 mm).

2.6 SAFETY RELIEF VALVES

- A. Manufacturers:
 - 1. Spence.
 - 2. Conbraco.
 - 3. Kunkle Valve – a division of Emerson Electric Co.
 - 4. McDonnell & Miller – a division of Xylem.
 - 5. Spirax Sarco.
 - 6. Watson McDaniel.

- B. Valve: Bronze Body, stainless steel valve spring, stem and trim, pop action, direct pressure actuated capacities ASME certified and labeled.

- C. Accessories: Drip pan elbow.

2.7 STRAINERS

- A. Manufacturers:
 - 1. Sarco.
 - 2. Barnes and Jones.
 - 3. Bell & Gossett – a division of Xylem.
 - 4. Flo-Fab.
 - 5. Keckley Co.
 - 6. Mueller Steam Specialty.
 - 7. Watson McDaniel.
 - 8. Wheatley.

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

- C. Size 2-1/2 inch to 4 inch: Flanged iron body for 300 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

- D. Size 5 inch and Larger: Flanged iron body for 300 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Steam Traps:
 - 1. Provide minimum 3/4 inch size on steam mains and branches.
 - 2. Install with union or flanged connections at both ends.
 - 3. Provide gate or ball valve and strainer at inlet, and gate or ball valve and check valve at discharge.
 - 4. Provide minimum 10 inch long, line size dirt pocket between apparatus and trap.
- C. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.
- D. In low pressure mains, provide 3/4 inch nipple in bottom of main, extending 3/4 inch into and above bottom of pipe. Provide dirt pocket with 1/2 inch low pressure thermostatic trap.
- E. Provide pressure reducing stations with pressure reducing valve, valved bypass, strainer and pressure gage on upstream side, relief valve and pressure gage on downstream side of pressure reducing valve.
- F. Pressure reducing station shall be 1 or 2 stages as indicated, to produce flat reduced pressure curve over range of capacity. Locate pilot operator control at least 4 feet downstream of valve.
- G. Rate relief valves for pressure upstream of pressure reducing station, for full operating capacity. Set relief at maximum 20 percent above reduced pressure.
- H. Terminate relief valves to outdoors in a safe location as directed. Provide drip pan elbow with drain connection to nearest floor drain.
- I. When several relief valve vents are connected to a common header, header cross section area shall equal sum of individual vent outlet areas.

END OF SECTION 232218

SECTION 232218 – STEAM AND CONDENSATE HEATING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Steam traps.
- B. Steam air vents.
- C. Pressure reducing valves.
- D. Steam safety valves.
- E. Strainers.

1.2 RELATED SECTIONS

- A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”
- B. Division 23 Section “Steam and Condensate Piping.”

1.3 REFERENCES

- A. ASME - Boiler and Pressure Vessel Codes, SEC 8-D - Rules for Construction of Pressure Vessels.
- B. ASME B31.9 - Building Services Piping.
- C. ASTM A105 - Forgings, Carbon Steel, for Piping Components.
- D. ASTM A126 - Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
- E. ASTM A216 - Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
- F. ASTM A395 - Ferric Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

1.4 SYSTEM DESCRIPTION

- A. Follow these guidelines unless otherwise indicated.
- B. Use Float and Thermostatic Traps for:
 - 1. Main headers.
 - 2. Branch lines.
- C. Use Inverted Bucket Steam Traps for:
 - 1. Main headers.

2. Branch lines.

1.5 PERFORMANCE REQUIREMENTS

- A. Steam Traps:
 1. Select to handle minimum of 2 times maximum condensate load of apparatus served.
 2. Where 2 traps are indicated on a coil or other equipment, select each for the full equipment condensate load.
 3. Pressure Differentials (unless otherwise indicated):
 - a. Low Pressure Steam (150 psi maximum): 40 psi.

1.6 SUBMITTALS

- A. Product Data:
 1. Provide for manufactured products and assemblies required for this project.
 2. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each specialty.
 4. Include electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Indicate application, selection, and hookup configuration. Include pipe and accessory elevations.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01 Section "Operation and Maintenance Data."
- B. Operation and Maintenance Data: Include installation instructions, servicing requirements, and recommended spare parts lists.

1.8 QUALITY ASSURANCE

- A. Perform Work in accordance with State and Municipality standards for installation of boilers and pressure vessels.
- B. Maintain 1 copy of each standards document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

1.10 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of steam and steam condensate piping and specialties.
- B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the

purpose indicated.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01 Section "Product Requirements."
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.12 EXTRA MATERIALS

- A. Furnish under provisions of Division 01 Section "Closeout Procedures."
- B. Provide 2 service kits for each size and type of steam trap.

PART 2 - PRODUCTS

2.1 INVERTED BUCKET TRAPS

- A. Manufacturers:
 - 1. Spirax Sarco.
 - 2. Armstrong International.
 - 3. Barnes and Jones.
 - 4. Hoffman Specialty – a division of Xylem.
 - 5. Watson McDaniel.
- B. Trap:
 - 1. Construction: ASTM A126 body of cast iron or stainless steel, with bolted cover, brass or stainless steel bucket, stainless steel seats and plungers, and stainless steel lever mechanism with knife edge operating surfaces.
- C. Rating: 250 psig shell design pressure up to 450 degrees F. Select operating differential pressure and orifice size as appropriate for system pressure.
- D. Features: Access to internal parts without disturbing piping, (cast iron bodies only) bottom drain plugs.
- E. Accessories: Integral bimetal air vent for quick startup, set to close at approximately 200 degrees F.

2.2 FLOAT AND THERMOSTATIC TRAPS

- A. Manufacturers:
1. Spirax Sarco.
 2. Armstrong International.
 3. Barnes and Jones.
 4. Hoffman Specialty – a division of Xylem.
 5. Watson McDaniel.
- B. Trap:
1. Construction: ASTM A126 cast iron or stainless steel body and bolted cover, stainless steel or bronze bellows type air vent, stainless steel float, stainless steel lever and valve assembly.
 2. Rating up to 450 degrees F:
 - a. Low Pressure Steam: 150 psig shell design pressure.
 3. Select operating differential pressure and orifice size as appropriate for system pressure.
 4. Features: Access to internal parts without disturbing piping, bottom drain plug.

2.3 STEAM AIR VENTS

- A. 125 psig WSP:
1. Manufacturers:
 - a. Spirax Sarco.
 - b. Armstrong International.
 - c. ITT Hoffman Specialty.
 2. Balanced Pressure Type: Model T202, cast brass body and cover; access to internal parts without disturbing piping; stainless steel bellows, stainless steel valve and seat.
- B. 225 psig WSP:
1. Manufacturers:
 - a. Spirax Sarco.
 - b. Armstrong International.
 - c. ITT Hoffman Specialty.
 2. Balanced Pressure Type: Series VS200, ASTM A126 cast iron body and cover; access to internal parts without disturbing piping; phosphor bronze bellows, stainless steel valve and seat.

2.4 STEAM VACUUM BREAKERS

- A. Manufacturers:
1. Spirax Sarco.
 2. Armstrong International.
 3. Hoffman Specialty.
 4. Watson McDaniel.
- B. Cast brass or stainless steel body and cover, stainless steel valve and seat; threaded inlet and outlet; access to inspect internal parts without disturbing piping; for 210 psig up to 500 degrees F; venting 4 CFM standard air at 6 in. Hg vacuum.

2.5 PRESSURE REDUCING VALVES

- A. Manufacturers:
 - 1. Spence.
 - 2. Armstrong International.
 - 3. Hoffman Specialty – a division of Xylem.
 - 4. Spirax Sarco.
 - 5. Watson McDaniel.

- B. Bronze or cast iron body, stainless or chrome steel valve spring, stem, and trim, phosphor bronze diaphragm, pilot operated, threaded up to 2 inches (50 mm), flanged over 2 inches (50 mm).

2.6 SAFETY RELIEF VALVES

- A. Manufacturers:
 - 1. Spence.
 - 2. Conbraco.
 - 3. Kunkle Valve – a division of Emerson Electric Co.
 - 4. McDonnell & Miller – a division of Xylem.
 - 5. Spirax Sarco.
 - 6. Watson McDaniel.

- B. Valve: Bronze Body, stainless steel valve spring, stem and trim, pop action, direct pressure actuated capacities ASME certified and labeled.

- C. Accessories: Drip pan elbow.

2.7 STRAINERS

- A. Manufacturers:
 - 1. Sarco.
 - 2. Barnes and Jones.
 - 3. Bell & Gossett – a division of Xylem.
 - 4. Flo-Fab.
 - 5. Keckley Co.
 - 6. Mueller Steam Specialty.
 - 7. Watson McDaniel.
 - 8. Wheatley.

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

- C. Size 2-1/2 inch to 4 inch: Flanged iron body for 300 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

- D. Size 5 inch and Larger: Flanged iron body for 300 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Steam Traps:
 - 1. Provide minimum 3/4 inch size on steam mains and branches.
 - 2. Install with union or flanged connections at both ends.
 - 3. Provide gate or ball valve and strainer at inlet, and gate or ball valve and check valve at discharge.
 - 4. Provide minimum 10 inch long, line size dirt pocket between apparatus and trap.
- C. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.
- D. In low pressure mains, provide 3/4 inch nipple in bottom of main, extending 3/4 inch into and above bottom of pipe. Provide dirt pocket with 1/2 inch low pressure thermostatic trap.
- E. Provide pressure reducing stations with pressure reducing valve, valved bypass, strainer and pressure gage on upstream side, relief valve and pressure gage on downstream side of pressure reducing valve.
- F. Pressure reducing station shall be 1 or 2 stages as indicated, to produce flat reduced pressure curve over range of capacity. Locate pilot operator control at least 4 feet downstream of valve.
- G. Rate relief valves for pressure upstream of pressure reducing station, for full operating capacity. Set relief at maximum 20 percent above reduced pressure.
- H. Terminate relief valves to outdoors in a safe location as directed. Provide drip pan elbow with drain connection to nearest floor drain.
- I. When several relief valve vents are connected to a common header, header cross section area shall equal sum of individual vent outlet areas.

END OF SECTION 232218

SECTION 232223 - STEAM CONDENSATE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes steam condensate pumps and condensate transfer tank.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated. Indicate pump's operating point on curves. Include receiver capacity and material.
- B. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 SINGLE-STAGE, CENTRIFUGAL PUMPS WITH FLOOR-MOUNTED RECEIVER

- A. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hurst Boiler
 - 2. Shipco Pumps

- B. Description: Factory-fabricated, packaged, electric-driven pumps; with receiver, pumps, controls, and accessories suitable for operation with steam condensate.
1. 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.
 2. ASME Compliance: Fabricate and label steam condensate receivers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. Configuration: Duplex floor-mounted pump with receiver and level switches; rated to pump 200 deg F steam condensate.
- D. Receiver:
1. Floor mounted.
 2. Welded steel.
 3. Horizontal cylinder.
 4. Externally adjustable float switches.
 5. Flanges for pump mounting.
 6. Water-level gage glass, and dial thermometer.
 7. Pressure gage at pump discharge.
 8. Bronze fitting isolation valve between pump and receiver.
 9. Lifting eyebolts.
 10. Inlet vent and an overflow.
 11. Cast-iron inlet strainer with vertical self-cleaning bronze screen and large dirt pocket.
 12. Magnesium anode.
 13. 3 inch suction valve with ball valve on bleed line.
 14. Temperature transmitter.
 15. Schedule 80 manifolded discharge piping, with globe balancing valve, silent check and gate isolation valve.
 16. Makeup assembly, consisting of 6" SLC controller, level and temperature transmitter, and solenoid valve with schedule 40 pipe and a 3-valve bypass, and wye strainer.
 17. Two-inch thermal insulation with aluminum jacket.
- E. Pumps:
1. Centrifugal, close coupled, vertical design.
 2. Permanently aligned.
 3. Bronze fitted.
 4. Replaceable bronze case ring.
 5. Mechanical seals rated at 250 deg F.
- F. Motor:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 2. Enclosure: Totally enclosed, fan cooled.
 3. Enclosure Materials: Cast iron.
 4. Motor Bearings: Permanently lubricated ball bearings.

5. Efficiency: Premium

G. Control Panel:

1. Factory wired between pumps and level switches, for single external electrical connection.
2. Provide fused, control-power transformer if voltage exceeds 230 V ac.
3. NEMA 250, Type 1 enclosure with hinged door and grounding lug, mounted on pump.
4. Liquid tight conduit.
5. Variable Frequency Drive for each pump.
6. Electrical pump alternator to operate pumps in lead-lag sequence and allow both pumps to operate on receiver high level.
7. Manual lead-lag control to override electrical pump alternator and manually select the lead pump.
8. Auto-off-continuous selector switches with test buttons for each pump.
9. Numbered terminal strip.
10. Fused disconnect switches.
11. Fused control transformer(s), 115 V sec.
12. Control circuit disconnect.
13. SLC color screen with BACnet IP compatible with existing Honeywell system.
14. SLC pump control 24 Volts DC
15. Alarm bell / Silence relay
16. Ext. switch & point for low water cutout.
17. Liquid filled pressure gauge assembly
18. 2-1/2" dial thermometer
19. High and low points

H. Capacities and Characteristics:

1. Capacity, Each Pump:
 - a. Flow: As scheduled.
 - b. Discharge Head: As scheduled.
 - c. Motor Horsepower: As scheduled.
2. Receiver:
 - a. Capacity: As scheduled.
 - b. Inlet Size: 6-inch flange.
3. Electrical Characteristics:
 - a. Volts: 120.
 - b. Phase: Single.
 - c. Hertz: 60.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install pumps according to HI 1.1-1.2, HI 1.3, and HI 1.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Support pumps and piping separately so piping is not supported by pumps.
- D. Install thermometers and pressure gages.
- E. Equipment Mounting:
 - 1. Install pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties."
- B. Where installing piping adjacent to machine, allow space for service and maintenance.
- C. Install compressed-air supply for pressure-powered pumps as required in Section 221513 "General-Service Compressed-Air Piping."
- D. Install a globe and check valve and pressure gage before inlet of each pump and a gate and check valve at pump outlet.
- E. Pipe drain to nearest floor drain for overflow and drain piping connections.

- F. Install full-size vent piping to outdoors, terminating in 180-degree elbow at point above highest steam system connection or as indicated.
- G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Clean strainers.
 - 3. Set steam condensate pump controls.
 - 4. Set pump controls for automatic start, stop, and alarm operation.
 - 5. Perform the following preventive maintenance operations and checks before starting:
 - a. Set float switches to operate at proper levels.
 - b. Set variable speed drives on pumps for specified flow.
 - c. Check motors for proper rotation.
 - d. Test pump controls and demonstrate compliance with requirements.
 - e. Replace damaged or malfunctioning pump controls and equipment.
 - f. Verify that pump controls are correct for required application.
 - 6. Start steam condensate pumps according to manufacturer's written startup instructions.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain steam condensate pumps.

END OF SECTION 232223

SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Listed double-wall chimneys.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Building-heating-appliance chimneys.
- B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

PART 2 - PRODUCTS

2.1 LISTED BUILDING-HEATING-APPLIANCE CHIMNEYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. American Metal Products; MASCO Corporation.
 - 2. Cleaver-Brooks; Div. of Aqua-Chem Inc.
 - 3. Hart & Cooley, Inc.
 - 4. Heat-Fab, Inc.
 - 5. Industrial Chimney Company.
 - 6. LSP Products Group, Inc.
 - 7. Metal-Fab, Inc.
 - 8. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
 - 9. Simpson Dura-Vent Co., Inc.; Subsidiary of Simpson Manufacturing Co.
 - 10. Tru-Flex Metal Hose Corp.
- B. Description: Double-wall metal vents tested according to UL 103 and rated for 1000 deg F continuously, or 1700 deg F for 10 minutes; with positive, neutral or negative flue pressure complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 2-inch annular space filled with high-temperature, ceramic-fiber insulation.
- D. Inner Shell: ASTM A 666, Type 304 stainless steel.

- E. Outer Casing: Aluminized Steel.
- F. 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.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Listed Building-Heating-Appliance Chimneys: Dual-fuel boilers, oven vents, water heaters, and exhaust for engines. Fireplaces and other solid-fuel-burning appliances.

3.2 INSTALLATION OF LISTED VENTS AND CHIMNEYS

- A. Locate to 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 and grease exhaust ducts 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. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- E. Lap joints in direction of flow.
- F. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- G. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- H. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 235239 - FIRE-TUBE BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes horizontal, packaged, factory-fabricated and -assembled fire-tube boilers, trim, and accessories for generating steam.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product include the following:
 1. Construction details, material descriptions, dimensions, and weights of individual components, profiles, and finishes for boilers.
 2. Rated capacities, operating characteristics, and furnished specialties and accessories.
 3. Predicted boiler efficiency while operating at design capacity and at varying part loads with basis indicated.
 4. Predicted emissions levels while operating at design capacity and at varying part loads with basis indicated. Indicate operation that produces worst-case emissions.
 5. Technical data for refractory and insulation, including temperature rating, thermal performance, attachment, and arrangement.
 6. Calculations showing predicted surface temperature of boiler jacket with basis indicated.
 7. Force and moment capacity of each piping and flue connection.
 8. Dimensioned location of low, high, and normal water level, showing operating set point and each alarm set point.
 9. Temperature and pressure rating, size, and materials of construction for boiler trim components, including piping, fittings, flanges, unions, and valves. Provide valve manufacturer's product data for each valve furnished. For safety valves, include trip and reset settings and flow capacity.
 10. Manufacturer's product data showing size, scale range, and accuracy of thermometers and pressure gages.
 11. Pressure rating, size, and materials of construction for boiler fuel train components including piping, fittings, flanges, unions, switches, and valves. Provide manufacturer's product data for each valve and switch furnished.
 12. Detailed information of controls, including product data with technical performance, operating characteristics, and sequence of operation.
 13. Product data for each motor, including performance, operating characteristics, and materials of construction.

- B. Shop Drawings: For boilers, boiler trim, and accessories.
 - 1. Include plans, elevations, sections, and foundation 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. Design calculations and base details, signed and sealed by a qualified professional engineer.
 - a. Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 4. Include diagrams for power, signal, and control wiring. Differentiate between factory and field installation.
 - 5. Include piping diagrams of factory-furnished piping that indicate size and each piping component.

1.4 INFORMATIONAL SUBMITTALS

- 1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Installation instructions.
 - C. Source quality-control reports.
 - D. Field quality-control reports.
 - E. Sample Warranty: For special warranty.
 - F. Other Informational Submittals:
 - 1. ASME Stamp Certification and Report: Submit ASME P-6 certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
 - 2. Startup service reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.
- B. Spare Parts List: Recommended spare parts list with quantity for each.

- C. Touch-up Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.
- D. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Tool kit to include the following:
 - 1. A tool kit specially designed by boiler manufacturer for use in servicing boiler(s) furnished.
 - 2. Special tools required to service boiler components not readily available to Owner service personnel in performing routine maintenance.
 - 3. Lockable case with hinged cover, marked with large and permanent text to indicate the special purpose of tool kit, such as "Boiler Tool Kit." Text size shall be at least 1 inch high.
 - 4. A list of each tool furnished. Permanently attach the list to underside of case cover. Text size shall be at least 0.5 inch high.
- B. Touch-up Paint: 32 oz. container of paint used for finish coat. Label on outside of container shall have a detailed description of paint to allow for procurement of a matching paint in the future.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Ship boilers from the factory free of water. Drain water and blow dry with compressed air if required to remove all water before shipping.
- B. Cover and protect flue, electrical controls, and piping connections before shipping. Protect and seal openings and connections with blinds, caps, plugs, and other materials during delivery, storage, and handling.
- C. Protect boiler components with removable temporary enclosures to prevent damage during shipping, storage, and installation.
- D. Package boiler for export shipping in totally enclosed crate with bagging.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace front- and rear-door refractories and heat exchangers of boilers that fail in materials or workmanship within specified warranty period.
 - 1. Horizontal Fire-Tube and Firebox Boilers: Refractory in front and rear doors, 10 years from date of startup by factory-authorized personnel.

PRODUCTS

1.9 PERFORMANCE REQUIREMENTS

A. Fuel-to-steam efficiency indicated shall be based on the following:

1. ASME Performance Test Code (PTC) 4, Input-Output method.
2. **<Insert test requirement>**.
3. Test Operating Conditions:
 - a. Ambient Temperature: **<Insert temperature>**.
 - b. Ambient Relative Humidity: **<Insert relative humidity>**.
 - c. Percent Excess Air in Exhaust Flue Gas: 15.
 - d. Fuel Heating Value: NG: 1000 BTU/CF, No.2 F.O.: 138,000BTU/Gal.

B. Gas-Fired Boiler Emissions: Not to exceed allowable ambient air quality standards in governing jurisdiction and indicated values.

1. Carbon monoxide:
 - a. 10 parts per million at any point from 100 percent to 10 percent fire.
2. Nitrogen compounds: 30 parts per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
3. Sulfur compounds: One part per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
4. Hydrocarbon and Volatile Organic Compounds: 10 parts per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
5. Particulate Matter: 0.01 lb/MMBtu.
6. Smoke: Not visible and not to exceed No. 1 on the Bacharach smoke scale.

C. Oil-Fired Boiler Emissions: Not to exceed allowable ambient air quality standards in governing jurisdiction and indicated values.

1. Carbon monoxide:
 - a. 10 parts per million at any point from 100 percent to 10 percent fire.
2. Nitrogen compounds: 30 parts per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
3. Sulfur compounds: One part per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
4. Hydrocarbon and Volatile Organic Compounds: 10 parts per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
5. Particulate Matter: 0.01 lb/MMBtu.
6. Smoke: Not visible and not to exceed No. 1 on the Bacharach smoke scale.

- D. Multiple Boiler Operation: Equip individual boilers in multiple boiler applications with integral controls to provide multiple boiler operation for optimum system performance, energy efficiency, Boilers B-1 and B-2, 300 BHP will alternate use and B-3, 150 BHP will trim the load and the following:
 - 1. Equalize runtime of boilers in service.
 - 2. Operate multiple boilers hot to minimize disruption of service in the event of single boiler failure.
 - 3. Configure controls so any boiler can be taken out of service with power disconnected and not impact multiple boiler operation.
 - 4. The boiler system shall be configured for (3) boilers.
 - E. Sound: Boiler sound level, measured according to parameters defined in ABMA publication "Boiler 304 Measurement of Sound from Steam Generators" shall not exceed 85 dBA at 3 feet.
 - F. Steam Quality: 99.5 saturated.
 - G. Operation Following Loss of Normal Power:
 - 1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to back-up power system shall automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a back-up power source or through normal power if restored before back-up power is brought online.
 - 2. Refer to Drawings for equipment served by back-up power systems.
 - 3. Provide means and methods required to satisfy requirement even if not explicitly indicated. Retain "Outdoor Installations" Paragraph below for boilers installed outdoors.
 - H. 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.
 - I. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.
 - J. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
 - K. ISO 14000 Certification: Boiler manufacturer to provide certification stating that it has self-certified its company to ISO 14000.
 - L. UL Compliance: Test Boilers for compliance with UL 726. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- 1.10 HORIZONTAL FIRE-TUBE BOILERS
- A. Pressure Vessel Design: Wet-back design with the following:

1. Two passes.
2. Minimum Heat-Exchanger Surface: 2.5 sq. ft..
3. Provisions for lifting boiler in-place.

B. Base:

1. Factory-mounted pressure vessel and other boiler components on steel saddles or supports that are fastened securely to a structural steel base that is constructed to make a complete self-supported unit requiring only a flat level surface for support.
2. Base included with attachments if required to secure boiler to structure.
3. Manufacturer's standard provisions for lifting include the following.
 - a. Designed for handling and installation conditions encountered.
 - b. Sufficient to carry total weight of fully assembled boiler with a safety factor of 1.2.

C. Shell:

1. Horizontal, cylindrical, steel pressure vessel of size to satisfy performance requirements indicated.
2. Manholes and Handholes:
 - a. Manhole for waterside inspection and access.
 - b. Handholes at front and rear of boiler for waterside inspections.
 - c. According to 2010 ASME Boiler and Pressure Vessel Code.
3. Steam Boilers:
 - a. Connections for steam supply, feedwater, level controls, and chemical treatment.
 - b. Baffle in shell below steam outlet to provide dry steam with no water carry over.
 - c. Bottom and surface blowdown connections.
 - d. Connections with safety relief valve(s).
 - e. Connections for other trim indicated.

D. Furnace:

1. Welded cylindrical steel chamber that is welded to steel tube sheets.
2. Arranged to provide uniform heat distribution under all firing conditions with no flame impingement on any refractory-covered or waterbacked surface.
3. Surrounded by water without interfering with natural circulation of water within shell.
4. Positioned from shell to inhibit unequal thermal stresses during operation.

E. Fire Tubes:

1. Steel, seamless or resistance welded.
2. Fitted in accurately sized holes in tube sheets and rolled in place.
3. Aligned to prevent noticeable deformation with undue stress when boiler is put in service.
4. Tube and tube sheet assembly shall be water- and gastight.
5. Arranged not to interfere with natural circulation of water in shell or to inhibit cleaning and flushing of water sides.
6. Readily removable from one end of boiler.

7. Provided without spinners, turbulators, and other inserted devices.

F. Flue:

1. Flanged connection located along top centerline of boiler and capable of supporting a field-installed flue stack with a weight of at least 1000 lb.
2. Equip boiler flue with bimetal thermometer in a stainless-steel case, with angle position adjustment and nominal 5-inch diameter face having a graduated scale and range of approximately 1.5 times the outlet temperature. Mount thermometer in a Type 316 stainless-steel thermowell that is located in a visible location to indicate flue-gas temperature.

G. Front and Rear Doors:

1. Hinged, sealed with heat-resistant gaskets and fastened with lugs and cap screws.
2. Designed so tube sheets and flues are fully accessible for inspection or cleaning when doors are open without the need to disconnect burner, blower, and fuel piping.
3. Include observation ports in doors at both ends of boiler for inspection of flame conditions.
4. Door refractory shall be accessible for inspection and maintenance.
5. Reinforce doors of dryback boilers to limit deflection due to thermal stresses and burner combustion pulsations to prevent progressive cracking and loosening of refractory.

H. Refractories:

1. Refractories retained shall withstand temperature occurring under maximum load conditions.
2. Formed or cast-in sections shall be easily replaceable through factory openings.
3. Secure refractory sections in position to withstand vibration and shock occurring during shipment, and to withstand burner combustion pulsations.
4. Where used for the burner combustion ring and rear or target baffle, refractories shall have a parametric cone equivalent of not less than 33.
5. Provide refractory for doors and end covers exposed to temperatures of 600 deg F and higher.
- 6.

I. Insulation:

1. Minimum 2-inch thick, mineral-fiber insulation surrounding the boiler shell and secured in place to prevent sagging or displacement.
2. Insulation of sufficient density or attached with reinforcement to prevent permanent deformation of protective jacket when subjected to an impact force associated with service personnel walking, kneeling, and laying on boiler while performing service.
3. Insulating value sufficient to limit exterior surface temperature of pressure vessel jacket, doors, and end covers from exceeding 140°F while operating in an indoor ambient environment with a temperature of 95°F, surface wind velocity of zero feet per minute, and boiler operating at full capacity.

J. Jacket: Sheet metal, with factory-applied protective finish.

1. Nominal Thickness: Not less than 0.048 inch.
2. Preformed shape to follow a smooth and uniform contour of pressure vessel and encapsulating insulation.
3. Consisting of multiple removable sections attached with corrosion-resistant screw-fasteners to facilitate removal and replacement multiple times.
4. Painted after assembly.

1.11 BURNER

- A. Burner designed to fire combination gas and oil. Single burner shall be used for dual fuels.
- B. Welded construction with multivane, stainless-steel, flame-retention diffuser.
- C. Single-tip retractable nozzle for low-pressure air-atomizing burner.
- D. Mount burner on hinged front access door to permit unrestricted access to combustion chamber.
- E. Burner Operation full modulating control to return to low-fire position for ignition.
 1. Combination Gas- and Oil-Fired Burner: 10 to 1 turndown.
- F. Burner Fuel Combustion Efficiency: Minimum 99.9 percent.
- G. Gas Pilot: Premix type with automatic electric ignition, complete with electronic flame scanner to monitor the pilot, so primary fuel valve cannot open until pilot flame has been established.
- H. Oil Pilot: Propane pilot ignition with 100 percent main-valve and pilot-safety shutoff solenoid with UV scanner flame-safety control.
- I. Manual adjustments not required to operate at varying loads.
- J. Performance shall be repeatable after changes in firing rate.
- K. Control devices and sequence shall comply with ASME CSD-1, FM and UL requirements.
- L. Damper: Designed to provide accurate control of combustion air with minimum hysteresis. Damper shall close when boiler is off.

1.12 BLOWER

- A. Combustion air supplied by a forced-draft blower assembly that is isolated to reduce vibration and noise.
- B. Mount blower on hinged front access door to permit unrestricted access to combustion chamber.
- C. Centrifugal type, with a forward-curve, backward-inclined airfoil or radial blade wheel.

- D. Blower and drive assembly shall be controlled through boiler's integral controls in response boiler manufacturer's prescribed sequence of operation that is coordinated with burner and fuel train to achieve performance indicated.
 - 1. Where indicated or required to achieve performance, provide blower with unit-mounted variable-frequency controller to vary blower speed in response to prescribed control set point and changes in operating conditions.
 - 2. Variable-speed fan operation shall be checked for resonant frequencies and adjusted to provide no resonant frequencies throughout entire operating range.
- E. Blower Drive Assembly: direct drive.
- F. Blower Motor:
 - 1. General Requirements: Comply with requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment" unless more stringent requirements are indicated below:
 - a. Efficiency: Premium efficient.
 - b. Enclosure: Totally enclosed, fan cooled.
 - c. Insulation Class: H.
 - d. Service Factor: 1.15 .
 - e. Motors operated through variable-frequency controllers shall be inverter duty rated according to NEMA MG-1.
 - 2. Motor Sizes: Minimum size as indicated and large enough so driven load does not require motor to operate in service factor.

1.13 GAS TRAIN

- A. Comply with Owner insurance underwriter requirements. In absence of specific requirements, comply with more stringent requirements indicated.
- B. Pilot gas piping train shall include:
 - 1. One manually operated, lubricated plug cock or ball valve upstream of all valves and accessories.
 - 2. One pressure regulator with vent.
 - 3. Pressure gage located downstream of pressure regulator. Nominal 2-inch diameter face with graduated scale to indicate gas pressure. Gage shall have normal operating pressure of about 50 percent of full range.
 - 4. Primary and secondary automatic valves to operate simultaneously.
 - 5. Normally open, full port electrically operated valve in a vent pipe connected between automatic valves.
 - 6. Manually operated valve with threaded plug located downstream of both automatic gas valves to permit leakage testing.
 - 7. **<Insert feature>**.
- C. Main gas piping train shall include:

1. Threaded pressure tapping with threaded plug upstream and downstream of valve and regulator.
 2. One manually operated, lubricated plug cock, ball valve, or butterfly valve upstream and downstream of all valves and accessories.
 3. One main pressure regulator with vent.
 4. Primary and secondary automatic valves to operate simultaneously.
 5. Manually operated gas valve with threaded plug located downstream of both automatic gas valves to permit leakage testing.
 6. Normally open, full port electrically operated valve in a vent pipe connected between automatic valves.
 7. Pressure gage with isolation valve located upstream and downstream of pressure regulator and at inlet to burner. Nominal 2-inch diameter face with graduated scale to indicate gas pressure. Gage shall have normal operating pressure of about 50 percent of full range.
 8. Proof of closure switch for each motor-operated valve and pressure regulator.
 9. Low-gas-pressure and high-gas-pressure switch.
- D. Control devices and sequence shall comply with ASME CSD-1, FM Global and UL requirements.
- E. Main gas valves shall be wired to close automatically in the event of power failure, low water level, or any safety shutdown condition.
- F. Mount pilot and main gas trains on side of boiler and support from boiler base.
- 1.14 OIL TRAIN
- A. Comply with Owner insurance underwriter requirements. In absence of specific requirements, comply with more stringent requirements indicated.
- B. Control devices and sequence shall comply with ASME CSD-1, FM Global and UL requirements.
- C. Low-Pressure Air-Atomizing System:
1. Separate air compressor module, factory mounted with burner-mounted, low-atomizing-air-pressure switch.
 2. Complete system for each burner, furnished by burner manufacturer, including compressor, drive, air filter, after cooler, low-pressure switch, and piping.
 3. Low-air-pressure switch interlocked to prevent burner operation if air pressure failure occurs.
 4. Motor shall comply with requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
- D. Oil Burner Piping:
1. Factory-installed fuel oil piping shall include the following:
 - a. Oil-pressure-regulating devices.

- b. Oil metering controls.
- c. Low-oil-pressure switch.
- d. Two motorized oil valves.
- e. Pressure gauges.

E. Piping Specialties:

- 1. Suction-line, manual shutoff valve.
- 2. Removable-mesh strainer.
- 3. Oil Filter: Oil filter with permanent edge-type elements that are cleanable by rotation of a handle without interruption to flow.
 - a. Element Spacing: 00.0035 inc.
 - b. Maximum Pressure Loss: 3 psig.
 - c. Provide with plugged drain.
- 4. 0- to 30-inch Hg vacuum; 0- to 30-psig vacuum-pressure gage.
- 5. 0- to 150-psig oil-nozzle pressure gage.
- 6. Nozzle-line, solenoid-safety-shutoff oil valve.
- 7. Relief valve located in discharge piping of oil pump with valve discharge connected to oil pump suction piping.

F. Main piping shall include the following (in order, starting at field connection and moving to burner):

- 1. Manual shutoff valve.
- 2. Removable-mesh strainer.
- 3. Oil filter.
- 4. Pressure gage with isolation valve.
- 5. Pressure regulator.
- 6. Low-pressure switch.
- 7. High-pressure switch.
- 8. Flow meter.
- 9. Flow control valve.
- 10. Thermometer.
- 11. Valved drain.
- 12. Automatic safety shutoff valve.
- 13. Valved leak test.
- 14. Automatic safety shutoff valve.
- 15. Valved leak test.
- 16. Manual shutoff valve.
- 17. Pressure gage with isolation valve.

G. Mount train on side of boiler and support from boiler base.

1.15 STEAM BOILER TRIM

- A. Include devices sized to comply with ASME B31.9.

- B. Pressure Controllers:, firing rate, and high limit.
- C. Safety Relief Valve:
 - 1. Size and Capacity: As required for equipment according to 20152010 ASME Boiler and Pressure Vessel Code.
 - 2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.
 - a. Drip-Pan Elbow: Cast iron and having flanged or threaded inlet and outlet with threads complying with ASME B1.20.1.
 - b. Exhaust Head: Install exhaust head on vent pipe connected to safety relief valve.
- D. Pressure Gage: Nominal 4-inch diameter face with graduated scale and siphon, with isolation valve to indicate pressure vessel steam pressure. Gage shall have boiler normal operating pressure of about 50 percent of full range and an accuracy of 1 percent full scale range.
- E. Bimetal Thermometer: Stainless-steel case with angle position adjustment and nominal 5-inch diameter face having a graduated scale with a range of approximately 1.5 times the outlet temperature. Mount thermometer in a Type 316 stainless-steel thermowell to indicate steam temperature inside pressure vessel.
- F. Water Column: Minimum 12-inch reflex glass gage with gage rods to protect glass, ball check and shutoff cocks, water column blowdown valves, and vacuum breaker. Midpoint of gage shall be at normal operating water level.
- G. Bottom Blowdown Valves: Factory-installed, duty-rated, slow-acting blowdown valves and interconnecting piping same size as boiler nozzle.
- H. Surface Blowdown Valves: Factory-installed, duty-rated isolation valves and interconnecting piping
- I. Stop Valves: Boiler outlets, except safety relief valves, shall be equipped with duty-rated stop valve in an accessible location as near as is practical to boiler nozzle and same size or larger than nozzle. Valves larger than NPS 2 shall have rising stem.
- J. Double Block and Bleed Gate Valves: Factory-installed, stop valves at boiler outlet with free-blow drain valve field installed between the two valves and visible when operating gate valves.
- K. Feedwater Valves: Factory-installed, duty-rated stop and check valves and interconnecting piping. Stop valves larger than NPS 2 shall have rising stem.
- L. Feedwater Valves: Factory-installed, three-valve bypass arrangement with modulating control valve positioned between duty-rated stop valves, bypass piping with throttling valve, check valve, and interconnecting piping. Stop and throttling valves larger than NPS shall have rising stem. Modulating control valve shall have the following features and characteristics:
 - 1. Duty rated with electric operator to control water level through boiler controls.
 - 2. Equal percentage flow characteristic.
 - 3. Valve Flow: 1.25 times boiler output.

4. Valve Pressure and Temperature Rating: Equal to boiler.
5. Shut-off Leakage: **0.0001** percent of valve coefficient.

M. Chemical Injection Assembly: Factory-installed, duty-rated injection quill with ball check valve and isolation valve compatible with dispensed chemical.

1.16 CONTROLS

A. Boiler operating controls shall include the following devices and features:

1. Control transformer(s) with fuse protection, as required by manufacturer, to implement requirements indicated. Provide transformer with 25 percent spare capacity.
2. Set-Point Adjust: Operating and alarm set points shall be field adjustable.

B. Pressure Control for Steam Boilers:

1. Operating-Pressure Control: Factory wired and mounted to control boiler to maintain boiler at constant pressure within 2 percent of set point.
2. High-Pressure Cutoff with Automatic Reset: Control stops burner if operating conditions rise above normal operating-pressure set point. Set point shall be adjustable.
3. High-Pressure Cutoff with Manual Reset: Control stops burner operation upon reaching adjustable high limit set point that is below safety valve setting.

C. Water-Level Control for Steam Boilers:

1. Operating Water-Level Control: Cycle feedwater pump(s) for water-level control.
2. Operating Water-Level Control: Operate feedwater pump(s) continuously and modulate boiler feedwater valve in response to **water level** for water-level control.
3. Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low water. Cutoff switch shall automatic]reset type.
4. Auxiliary Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low-water alarm limit. Cutoff switch shall be manual-reset type.
5. Microprocessor-based control.
6. Accuracy within 0.01.
7. Visual indication of level, alarms, and errors through alphanumeric display.
8. Features:
 - a. Continuous water-level indication.
 - b. Low-water cutoff and alarm.
 - c. High-water alarm.
 - d. Low- and high-water warning.
 - e. Control of modulating feedwater control valve.
 - f. Auxiliary low-water cutoff check.
 - g. Auto and manual reset.
 - h. Alarm annunciation.

D. Multiple Boiler Operation: Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

- E. Boiler Emergency Shutdown: Interlock with field-installed boiler emergency shutdown switch to shut down boiler when activated. Manufacturer to furnish break-glass-type switch with permanent nameplate titled "Boiler Emergency Shutdown" for field installation.
- F. Chemical Feed System Interface: Dry contacts to interface control and operation of chemical feed pump.
- G. Burner Safety Controls for Steam Boilers: To maintain safe operating conditions, burner safety controls limit burner operation.
 - 1. High Cutoff: Automatic and Manual reset stops burner if operating conditions rise above maximum boiler operating pressure.
 - 2. Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic-reset type.
 - 3. Auxiliary Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low-water alarm limit. Cutoff switch shall be manual-reset type.
 - 4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
- H. Burner Safety Controls for Hot-Water Boilers: To maintain safe operating conditions, burner safety controls limit burner operation.
 - 1. High Cutoff: Automatic and Manual reset stops burner if operating conditions rise above boiler design temperature.
 - 2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual reset type.
 - 3. Auxiliary Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low-water alarm limit. Cutoff switch shall be manual-reset type.
 - 4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
- I. Burner Flame Safeguard Controls:
 - 1. Factory equipped with flame safeguard control and infrared flame scanner.
 - 2. Microprocessor-based, solid-state control having sequence and flame-on visual indication and fault code indications of flame safeguard trip functions.
 - 3. Control shall include dynamic self-check logic.
 - 4. Control shall have a fixed operating sequence incapable of being manually altered that includes start, prepurge, pilot and main fuel ignition run, and postpurge cycles.
 - 5. Control shall be nonrecycle type for maximum safety that shall shut down the burner and indicate, as a minimum, the following trip functions:
 - a. Pilot and main flame failure.
 - b. High- and low-fire proving switch faults.
 - c. Running interlocks open.
 - d. False flame signal and fuel valve open.
 - 6. Control shall include a run/test switch to allow interruptions to sequence just after prepurge and during pilot ignition trial, and run cycles for adjustments to firing rate motor, damper linkages, and pilot flame for minimum turndown tests.

- J. Combustion-Air Controls: Factory equipped with motor-operated combustion-air damper and blower control to regulate burner fire according to load demand.
- K. Oxygen Trim Control:
1. Provide oxygen trim system to continuously monitor and display oxygen concentrations in boiler flue gas and adjust fuel and airflow to maintain an adjustable oxygen-level set point.
 2. System shall compensate for changes in ambient temperature, barometric pressure, humidity, and variations in fuel characteristics.
- L. Surface Blowdown Control: Provide a conductivity sensor and control circuitry to operate an automatic control valve in surface blowdown piping to maintain total dissolved solids (TDS) within boiler manufacturer's prescribed level.
- M. Honeywell Building Automation System Interface: Factory install hardware and software to enable system to monitor, control, and display boiler status and alarms.
1. Hardwired I/O Points:
 - a. Monitoring: On/off status, common trouble alarm
 - b. Control: Local Control only
 2. Communication Interface: BACnet communication interface shall enable control system operator to remotely monitor boiler operation from an operator workstation. Control features are available, and monitoring points are displayed locally at boiler-control panel through the interface.
- N. Integrated Boiler-Control System:
1. Integral control of burner management for flame safety, boiler modulation, and operator interface functions with features and functions indicated.
 2. Factory preconfigured.
 3. Utilizing solid-state controls and sensors to provide various control functions, including the following:
 - a. Automatic sequencing of the boiler through standby, prepurge, pilot flame establishing period, main flame establishing period, run, flame proving and lockout, and postpurge.
 - b. Full modulating control of air and fuel through Proportional-Integral-Derivative (PID) algorithm.
 - c. Thermal shock protection.
 - d. High and low limit alarms and shutdowns.
 4. Local operator interface through nominal 10-inch color touch screen graphical display for setup, monitoring, and data acquisition.
 - a. Manual control of the boiler firing rate using control screens to increment or decrement firing rate.
 - b. Indication of burner management controller status and diagnostics.

- c. Display of system alarms and faults.
 - d. Display of history of alarms and faults.
 - e. Display of recommendations for troubleshooting of fault conditions.
 - f. Display of water-level indication and alarm(s).
 - g. Stack flue-gas, combustion-air, and shell water-temperature indication.
 - h. Boiler efficiency calculation and display.
 - i. Low-fire hold with minimum temperature control.
 - j. Assured low-fire cutoff (ALFCO).
 - k. High stack temperature annunciation with auto cutoff.
 - l. Audible alarm and silencing through touch screen intervention.
5. Fully integrated control of the following:
- a. Blower operation and combustion-air damper for varying operating conditions.
 - b. Oxygen trim and monitoring to compensate for combustion-air variations.
 - c. Parallel positioning for independent fuel and air control for enhanced fuel efficiency.
 - d. Multiple boiler lead/lag control with hot standby.
 - e. Draft control for maintaining proper and consistent draft for enhanced fuel efficiency.
6. E-mail and paging feature to multiple contacts via Internet and phone line independent of control system interface.
7. LAN/WAN interface with remote monitoring software to allow remote monitoring independent of control system interface.
- O. Control Enclosures:
1. NEMA 250, Type 12.
 - a. Provide enclosure with integral vents, fans, heater, and air conditioner as required to automatically control temperature inside enclosure within safe operating limits of devices installed within the enclosure.
 2. Wiring shall be numbered and color-coded to match wiring diagram. Provide a laminated wiring diagram located inside enclosure.
 3. Mounted on boiler assembly at a location convenient to operator.
 4. Provide hinged full-size door with key lock. Provide common key for all locks.
 5. Enclosure shall consist of multiple sections divided by a partition with a separate hinged door for each section. One section shall house low-voltage controls and other section shall house line voltage controls.
 6. Enclosure shall house the following:
 - a. Control transformers with fuses.
 - b. Labeled terminal strips.
 - c. Controller(s) to provide control and alarm functions indicated.
 - d. Audible indication of safety alarms.
 7. Face of enclosure shall provide the following:

- a. Visual indication of operating components and alarms.
 - b. Auto/local capability to allow operator to manually operate boiler locally.
 - c. Audible alarm-silence capability.
 - d. Labels for switches, lights, and displays to provide clear indication of service.
- P. Control Instrument Enclosures: Control instruments and devices that are mounted on the boiler assembly and cannot be installed inside the control enclosure shall have same or higher level of protection indicated for control enclosures.
- Q. Control Cable and Wire:
1. Control cable and wiring shall be numbered and color-coded to match wiring diagram.
 2. Install cable and wiring located outside of enclosure(s) in a metal raceway. Use flexible conduit to make final terminations. Provide watertight installation for applications exposed to moisture.

1.17 ELECTRICAL POWER

- A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
1. Enclosure: NEMA 250, 12.
 - a. Enclosure shall have integral vents, fans, heat, and air conditioner as required to automatically control temperature inside enclosure within safe operating limits of devices installed within the enclosure.
 - b. Mounted on boiler assembly at a location convenient to operator.
 - c. Enclosure shall have hinged full-size door with key lock with common key for all locks.
 2. Wiring shall be numbered and color-coded to match wiring diagram. Provide a laminated wiring diagram located inside enclosure.
 3. Install wiring outside of an enclosure in a metal raceway. Make final connections to motors using flexible conduit. Provide watertight installation for applications exposed to moisture.
 4. Field power interface shall be to fused disconnect switch and/or circuit breaker. Withstanding rating of disconnecting means shall protect equipment. Coordinate requirements with field electrical power source.
 5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
 6. Provide each motor with NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection. Provide variable-frequency controller with manual bypass and line reactors for each variable-speed motor indicated.
 7. Provide transformer with fuses and power wiring to power a 20-A 120-V duplex receptacle mounted in each boiler control panel for use in connecting analytical and testing equipment.

1.18 FINISH

A. General:

1. Paint boiler, using manufacturer's standard procedures, except comply with requirements indicated.
2. Miscellaneous surfaces shall be finished to match continuous surfaces.
3. Manufacturer shall field touch up or entirely repaint surface finishes, which were damaged during shipment, to original condition, using original materials and methods.
4. Paint shall be suitable for temperatures encountered on painted surfaces.
5. Requirements indicate minimum quality level. Provide more robust paint system if required to comply with other requirements indicated.

B. Preparation:

1. Follow paint manufacturer's published preparation and application instructions.
2. When paint manufacturer's recommended preparation requirements differ from those specified, use more stringent requirements.
3. Structural steel with visible corrosion shall be sandblasted according to SSPC SP-6 or SSPC SP-10 before applying primer and paint.
4. Before application of a primer and a top coat, remove oil and grease from surfaces to be coated using clean rags soaked in thinner according to SSPC SP-1.
5. Treat galvanized-steel surfaces that cannot be procured with a phosphatized finish with a phosphate rinse to ensure proper paint adhesion.

C. Primer:

1. Rust-inhibiting type with a minimum dry film thickness of 2 mils.
2. Provide multiple passes if required to prevent runs.
3. Select a primer that is compatible with substrate and finish coat.

D. Finish Coat:

1. Finish coat shall be [alkyd enamel] [epoxy] [polyurethane] <Insert type>.
2. Use dry film thickness recommended by paint manufacturer, but not less than 2 mils. Provide multiple passes if required to prevent runs.

E. Paint the following surfaces with both a primer and finish coat:

1. Base and miscellaneous supports that are not hot dip galvanized.
2. Carbon steel that is not galvanized.
3. Exterior surfaces of unit exposed to view.
4. Piping and trim.

F. Do not paint aluminum or stainless steel.

G. Accessories:

1. Inlet and Outlet Transitions: Designed by economizer manufacturer and furnished with economizer.

2. Safety Relief Valve: Selected by economizer manufacturer according to 2015 ASME Boiler and Pressure Vessel Code requirements.
3. Soot Blowers: Steam-operated, rotating valve-in-head. Provide sufficient number to clean all tube areas. Location, arrangement, and quantity based on recommendations of soot blower manufacturer for type and size of economizer furnished.
4. Thermometers:
 - a. Water Inlet and Discharge Thermometers: Bimetal thermometer in a stainless-steel case with angle position adjustment, nominal 5-inch diameter face having graduated scale and range of approximately 1.5 times the discharge temperature. Mount thermometer in a Type 316 stainless-steel thermowell that is located in a visible location to indicate water inlet and discharge temperature.
 - b. Flue-Gas Inlet and Discharge Thermometers: Bimetal thermometer in a stainless-steel case with angle position adjustment, nominal 5-inch diameter face having graduated scale and range of approximately 1.5 times the inlet temperature. Mount thermometer in a Type 316 stainless-steel thermowell that is located in a visible location to indicate flue-gas inlet and discharge temperature.

H. Factory Test and Inspections:

1. Inspect completed economizer assembly according to 2015 ASME Boiler and Pressure Vessel Code.
2. Certify inspection and submit completed ASME form for each economizer.

1.19 CAPACITIES AND CHARACTERISTICS

- A. Heating Medium: Steam.
- B. Design Pressure Rating: 125 psig.
- C. Safety Relief Valve Setting: 100 psig.
- D. Entering-Water Temperature: 160 deg F.
- E. Steam Operating Pressure: 70 psig .
- F. Steam-Flow Rate: 150 bhp boiler: 4300 lb/h, 300 bhp boiler: 8500lb/h
- G. Fuel-to Steam Efficiency: 82 percent.
- H. Number of Passes Two
- I. Gas Input: 150 bhp boiler: 5,000 MBH, 300 bhp boiler: 10,000 MBH
- J. Gas Input Flow: 150 bhp boiler: 5025 cfh, 300 bhp boiler: 10,050 cfh
- K. Gas Pressure: <1 psig.

- L. Oil Input: 150 bhp boiler: 4120 MBH, 300 bhp boiler: 8240 MBH
- M. Output Capacity: 150 bhp boiler: 3378 MBH, 300 bhp boiler: 6756 MBH .
- N. Burner Blower:
 - 1. Motor Horsepower: 7.5 hp. 150 BHP Boiler and 20 hp 150 BBHP Boiler
- O. Electrical Characteristics:
 - 1. Volts:460 V.
 - 2. Phase: Three.
 - 3. Hertz: 60 Hz.
- P. Sound (decibels, A weighted): 85 dB.

1.20 SOURCE QUALITY CONTROL

- A. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.
- B. Burner and Hydrostatic Test:
 - 1. Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve performance requirements indicated.
 - 2. Perform hydrostatic test of pressure vessel, piping, and trim of assembled boiler.
- C. Witness Testing:
 - 1. Allow Owner access to witness source quality-control test reports for boilers.

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and flue; piping; controls; and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
 - 1. Boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for flue, piping, controls, and electrical connections.
- B. Examine areas where boilers will be installed for suitable conditions.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

2.2 BOILER INSTALLATION

- A. Coordinate size and location of bases. Cast anchor-bolt inserts into concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Equipment Mounting:
 - 1. Install boilers on existing cast-in-place concrete equipment base(s).
- C. Install gas-fired boilers according to NFPA 54.
- D. Install gas-fired boilers according to NFPA 58.
- E. Install oil-fired boilers according to NFPA 31.
- F. Assemble and install boiler trim, components, and accessories that are not factory installed.
- G. Install control and electrical devices furnished with boiler that are not factory mounted.
- H. Install control and power wiring to field-mounted control and electrical devices furnished with boiler that are not factory installed.
- I. Perform boil-out and cleaning procedures according to manufacturer's written instructions after completion of hydrostatic testing and before performing other field tests. Boiler manufacturer's factory-authorized representative shall witness boil-out and cleaning procedures. Following boil-out and cleaning procedures, boiler shall be washed and flushed until water leaving boiler is clear.
- J. Protect boiler fireside and waterside from corrosion.
 - 1. Before boiler is filled with water, protect by dry storage method recommended by boiler manufacturer.
 - 2. After boiler is filled with water, and left not fired for more than 10 days, protect by wet storage method recommended by boiler manufacturer.
 - 3. Chemical Treatment: Quality of water in boilers shall be maintained by a professional water-treatment organization that shall provide on-site supervision to maintain the required water quality during periods of boiler storage as well as during operating, standby, and test conditions.

2.3 PIPING 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 boiler(s), allow space for service and maintenance.
- C. Connect gas piping to boiler gas-train inlet with dirt leg, shutoff valve, and union or flange. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

- D. Connect oil piping to oil-train connection with dirt leg, shutoff valve, and union. Piping shall be at least full size of oil-train connection. Provide a reducer if required. Provide drain valve with threaded plug at piping low point.
- E. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.
- F. Connect steam and condensate piping to supply-, return-, and blowdown-boiler connections with union or flange at each connection. Provide each connection with shutoff valve if shutoff valves are not factory furnished with boiler trim.
- G. Install piping from safety relief valves to nearest floor drain.
- H. Install piping from safety valves and drip-pan elbows. Extend piping from safety valves and terminate to vent outdoors. Extend piping from drip-pan elbow drain to nearest floor drain.
- I. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- J. Hot equipment drains connected to sanitary drainage system shall be cooled before discharging into the system if required to comply with more stringent of governing code requirements and requirements indicated.
- K. Connect chemical-treatment piping to each boiler chemical-treatment connection with check valve and isolation valve.

2.4 FLUE CONNECTIONS

- A. Connect breeching to full size of boiler outlet. Install like in kind chimney breech and stack to match the existing chimney system. Install easily accessible test ports for field testing of flue gas from each boiler.

2.5 ELECTRICAL POWER CONNECTIONS

- A. Connect wiring and ground equipment according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

2.6 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between boilers and other equipment to interlock operation as required, to provide a complete and functioning system.
- C. Connect control wiring between boiler control interface and Honeywell building automation system for remote monitoring and control of boilers. Comply with requirements in

2.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Hydrostatic Leak Test: Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
 - b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and steam pressure.
 - c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Boiler will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
- G. Performance Tests:
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
 - 2. Boilers shall comply with performance requirements indicated, as determined by field-performance tests. Adjust, modify, or replace equipment in order to comply.
 - 3. Perform field-performance tests to determine the capacity and efficiency of boilers.
 - a. For dual-fuel boilers, perform tests for each fuel.
 - b. Test for full capacity.
 - c. Test for boiler efficiency at low fire, 10, 20, 30, 40, 50, 60, 70, 80, 90, and high fire (100) percent of full capacity. Determine and document efficiency at each test point.
 - 4. Test each safety valve. Record pressure at valve blowdown and reset. Test valve(s) with boiler operating at full capacity to ensure valve has capacity to prevent further rise in pressure.

5. For boilers equipped with automatic oxygen trim control, conduct tests with automatic oxygen trim control on manual at zero trim and record performance. Repeat tests with automatic oxygen trim control under automatic control and record performance.
6. Repeat tests until results comply with requirements indicated.
7. Provide measurement and analysis equipment required to determine performance.
8. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
9. Notify Owner 20 days in advance of test dates.
10. Document test results in a report and submit with informational submittals.

2.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Two 4 hours sessions will be conducted to accommodate all of Owner's staff.

END OF SECTION 235239

SECTION 235313 - BOILER FEEDWATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes boiler feedwater pumps.

1.3 DEFINITIONS

- A. NPSHR: Net-positive suction head required.

1.4 ACTION SUBMITTALS

- A. Product Data: For each unit to include the following:
 - 1. Equipment performance and operating characteristics, such as rated feedwater flow rates; temperature and NPSHR; and pump performance curves with selection points clearly indicated.
 - 2. Furnished specialties and accessories.
 - 3. Construction details, material descriptions, dimensions and weight of individual components, and profiles and finishes.
 - 4. Temperature and pressure rating, size, and materials of construction for trim components including piping, fittings, flanges, unions, and valves. Provide valve manufacturer Product Data for each valve furnished. Product Data for each motor, including performance, operating characteristics, and materials of construction.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and mounting 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. Include diagrams for power, signal, and control wiring. Differentiate between factory and field installation.
 - 4. Include piping diagrams of factory-furnished piping that indicate size and each piping component.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plan and elevation views, drawn to scale, indicating equipment manufacturer's service clearances, structure and base attachment, piping, power, and controls. Each view to show screened background with the following:
 - 1. Column grids, beams, columns, and concrete equipment bases.
 - 2. Room layout with walls, floors, and roofs, including each room name and number.
 - 3. Equipment and products located in vicinity of boiler feedwater pumps and part of final installation including products of other trades, such as lighting, fire suppression systems, and plumbing systems.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For feedwater equipment to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Gaskets: Furnish one replacement gasket(s) for each gasketed opening.
 - 2. Pump Mechanical Seal Set: Furnish one replacement mechanical seal set(s) for each unique pump mechanical seal.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Shipping:
 - 1. Clean flanges and exposed-metal surfaces and treat with anticorrosion compound after assembly and testing.
 - 2. Protect flanges, pipe openings, and nozzles with flange covers or with screwed-in plugs.
 - 3. Ship boiler feedwater pumps from the factory free of water. Drain water and blow pumps dry with compressed air if required to remove all water before shipping.
 - 4. Cover and protect electrical and control devices and open connections.
- B. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- C. Comply with manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASME Compliance:

1. Fabricate and label unit receivers of boiler feedwater pumps according to ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
2. Factory-installed piping that connects pumps to receivers shall comply with ASME B31.1, "Power Piping."
3. Safety valves and pressure vessels shall bear the appropriate ASME label.

B. Operation Following Loss of Normal Power:

1. Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system shall automatically return equipment and associated controls to the state in which equipment was operating immediately before loss of normal power. This shall be accomplished without need for manual intervention by an operator when power is restored either through a backup power source or through normal power if restored before backup power is brought on-line.
2. See Drawings for equipment served by backup power systems.
3. Provide means and methods required to satisfy requirement even if not explicitly indicated.

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.

2.2 FEEDWATER PUMPS

A. Manufacturers: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

1. Goulds Pump
2. Grundfos Pumps Corporation

B. Vertical Feedwater Pump: Flange-mounted, close-coupled, multistage, radially split-case-design centrifugal pump; rated for 300 psig minimum working pressure and a continuous water temperature of at least 225 deg F; with the following features:

1. Impeller: Stainless steel.
2. Seals: Mechanical.
3. Motor: Totally enclosed fan-cooled enclosure.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test performance and submit test results on packaged boiler feedwater pump units, according to ASME PTC 12.1, before shipping to Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting feedwater unit performance, maintenance, and operations.
 - 1. Boiler feedwater pump unit locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, control, and electrical connections.
- B. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping to verify actual locations of piping connections before installation of boiler feedwater pumps.
- C. Examine areas for suitable conditions where boiler feedwater pumps will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate size and location of bases. Cast anchor-bolt inserts into concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Equipment Mounting:
 - 1. Install feedwater units on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
- C. Install unit to permit access for maintenance.
- D. Support piping independent of equipment.
- E. Install parts and accessories shipped loose.
- F. Install control and electrical devices furnished with units that are not factory mounted.
- G. Install control and power wiring to field-mounted control and electrical devices furnished with units that are not factory installed.
- H. Protect units from corrosion.
 - 1. Before filling with water, protect by dry storage method recommended by manufacturer.
 - 2. After filled with water, protect by wet storage method recommended by manufacturer.

3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to boiler feedwater pumps, allow space for service and maintenance.

3.4 ELECTRICAL POWER CONNECTIONS

- A. Ground equipment and connect the wiring according the Electrical specification sections.

3.5 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between boiler feedwater pump units and other equipment to interlock operation as required to provide a complete and functioning system.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Check bearing lubrication.
 - 4. Verify proper motor rotation.
 - 5. Startup service.
 - 6. Report results in writing.
- B. Boiler feedwater pump will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.7 ADJUSTING

- A. Adjust boiler water-level controls to properly stage unit.
- B. Set field-adjustable controls.

3.8 CLEANING

- A. Clean equipment internally; remove coatings applied for protection during shipping and storage, foreign material, and oily residue according to manufacturer's written instructions. Following cleaning procedures, unit shall be washed and flushed until water leaving unit is clear.
- B. Clean strainers.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain boiler feedwater units.
- B. Video training sessions, and provide electronic copy of video to Owner.

END OF SECTION 235313

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

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

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer's authorized service representative.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

- D. Conductor Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One hole with standard barrels.
 - 3. Termination: Compression.

2.3 GROUNDING CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Grounding Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- C. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- B. Branch Circuits in Cable Tray: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Three-phase motor and appliance branch circuits.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Metal wireways and auxiliary gutters.
 - 3. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. GRC: Comply with ANSI C80.1 and UL 6.
 - 3. EMT: Comply with ANSI C80.3 and UL 797.
 - 4. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
 - 1. Comply with NEMA FB 1 and UL 514B.
 - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 4. Fittings for EMT:

- a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
5. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Screw-cover type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

2.3 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- G. Gangable boxes are allowed.
- H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Fiberglass.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

I. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
3. Damp or Wet Locations: GRC.
4. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

B. Minimum Raceway Size: 3/4-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

BUREAU OF REAL ESTATE MANAGEMENT
EAST CAMPUS STEAM PLANT REPLACEMENT
ISSUED FOR BID

MAY 22, 2019

- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- F. Support conduit within 12 inches of enclosures to which attached.
- G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- H. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- J. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- K. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- M. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- P. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.
 - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6. Where otherwise required by NFPA 70.

BUREAU OF REAL ESTATE MANAGEMENT
EAST CAMPUS STEAM PLANT REPLACEMENT
ISSUED FOR BID

MAY 22, 2019

- Q. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit forequipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- R.
- S. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- T. Locate boxes so that cover or plate will not span different building finishes.
- U. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- V. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
- 2. Labels.
- 3. Fasteners for labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.

- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded branch-circuit conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Color for Neutral: White.
 - 5. Color for Equipment Grounds: Green with a yellow stripe.
 - 6. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
 - 2. .
- D. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- E. Equipment Identification Labels:
 - 1. Black letters on a white field.
 - 2.

2.3 LABELS

- A. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
- B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Verify identity of each item before installing identification products.
- C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- D. Apply identification devices to surfaces that require finish after completing finish work.
- E. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.

F. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

G. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

H. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

I. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

1.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use [**vinyl wraparound labels**] [**self-adhesive wraparound labels**] [**snap-around labels**] [**snap-around color-coding bands**] [**self-adhesive vinyl tape**] to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

D. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

BUREAU OF REAL ESTATE MANAGEMENT
EAST CAMPUS STEAM PLANT REPLACEMENT
ISSUED FOR BID

MAY 22, 2019

- a. Power-transfer switches.
- b. Controls with external control power connections.

F. Equipment Identification Labels:

- 1. Indoor Equipment: Self-adhesive label.
- 2. Equipment to Be Labeled:
 - a. Enclosures and electrical cabinets.
 - b. Enclosed switches.
 - c. Enclosed circuit breakers.
 - d. Enclosed controllers.
 - e. Push-button stations.
 - f. Contactors.

END OF SECTION 260553

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 600-V ac.
 - 4. 200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
 - 7. .

2.3 NONFUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Construction Manager's written permission.
 - 4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 3. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.

- E. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

END OF SECTION 262816

SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.2 DEFINITIONS

- A. CE: Conformance Europeene (European Compliance).
- B. CPT: Control power transformer.
- C. DDC: Direct digital control.
- D. EMI: Electromagnetic interference.
- E. OCPD: Overcurrent protective device.
- F. PID: Control action, proportional plus integral plus derivative.
- G. RFI: Radio-frequency interference.
- H. VFC: Variable-frequency motor controller.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
- B. Shop Drawings: For each VFC indicated.
 - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product certificates.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. General Requirements for VFCs:
 - 1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.
- B. Application: Variable torque.
- C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
 - 1. Units suitable for operation of NEMA MG 1 motors.
 - 2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- F. Unit Operating Requirements:
 - 1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
 - 2. Input AC Voltage Unbalance: Not exceeding 3 percent.

3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
 6. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
 7. Humidity Rating: Less than 95 percent (noncondensing).
 8. Vibration Withstand: Comply with NEMA ICS 61800-2.
 9. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 10. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 11. Speed Regulation: Plus or minus 5 percent.
 12. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
 13. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- G. Inverter Logic: Microprocessor based, 16 or 32 bit, isolated from all power circuits.
- H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical.
- I. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 0.1 to 999.9 seconds.
 4. Deceleration: 0.1 to 999.9 seconds.
 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- J. Self-Protection and Reliability Features:
1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 3. Under- and overvoltage trips.
 4. Inverter overcurrent trips.
 5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
 6. Critical frequency rejection, with three selectable, adjustable deadbands.
 7. Instantaneous line-to-line and line-to-ground overcurrent trips.
 8. Loss-of-phase protection.
 9. Reverse-phase protection.
 10. Short-circuit protection.
 11. Motor-overtemperature fault.

- K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- P. Integral Input Disconnecting Means and OCPD: NEMA KS 1, fusible or nonfused switch with pad-lockable, door-mounted handle mechanism.
 - 1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
 - 2. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.

2.2 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
 - 1. Power on.
 - 2. Run.
 - 3. Overvoltage.
 - 4. Line fault.
 - 5. Overcurrent.
 - 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
 - 1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 - 2. Security Access: Provide electronic security access to controls through identification and password with at least one level of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

- C. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
 2. Running log of total power versus time.
 3. Total run time.
 4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. DDC system interface with existing Honeywell BACnet system for monitoring and control.
 2. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: 4- to 20-mA dc.
 3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 4. Output Signal Interface: A minimum of one programmable analog output signal(s) (4- to 20-mA dc), which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).

- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

- 1. Number of Loops: One.

2.3 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.4 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
 - 1. Push Buttons: Unguarded.
 - 2. Pilot Lights: Push to test.
 - 3. Selector Switches: Rotary type.
- B. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
 - 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
- C. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses in each fusible-switch VFC.
- B. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

- C. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- D. Comply with NECA 1.

3.2 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.

3.3 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFC with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. VFCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.5 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable pressure switches.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 262923