PROJECT NO. DGS C-0503-0027 PHASE 001
Replace Steam Generation Equipment

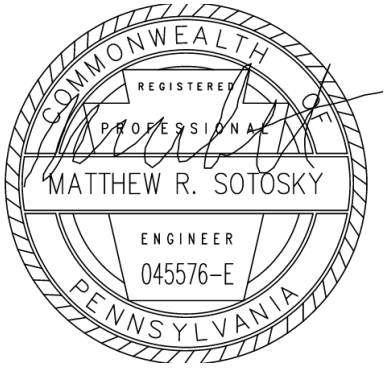
PROJECT MANUAL FOR THE CONSTRUCTION CONTRACT

Danville State Hospital
Danville, Pennsylvania

CONTRACT NO. C-0503-0027 PHASE 001

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF GENERAL SERVICES
HARRISBURG, PENNSYLVANIA

Josh Shapiro, Governor
Reginald B. McNeil, II, Secretary



10/01/2024

October 10, 2024
The Department of General Services
Bureau of Pre-Construction

Harrisburg, PA 17125

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DIVISION 01

GENERAL REQUIREMENTS

SECTION 01 0100 - SUMMARY OF WORK

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 LOCATION

A. Danville State Hospital, 50 Kirkbride Drive, Danville, Mahoning Township, Montour County, PA

1.3 PROJECT DESCRIPTION

A. Replace the existing coal fired boilers and their associated equipment with reliable, energy efficient, gas fired tube package boilers and supporting auxiliary equipment.

1.4 CONTRACT DURATION

A. The Construction Contract duration shall be **392** calendar days commencing on the date of the Initial Job Conference.

B. Refer to Section 013100 for how the contract duration may be impacted by long lead-time materials and equipment.

1.5 WORK INCLUDED

A. The Work of this Project consists of, but is not necessarily limited to, the following. Detailed requirements of the Work are described in the pertinent specification Sections and/or shown on the Drawings.

B. General Construction (.1) Contract:

1. Demolition of existing wall. Furnish and install 2 new roll up doors for access and clearance of new boilers B-2 and B-3.
2. Demolition of existing wall. Furnish and install a new man door for egress.
3. Concrete and structural repair to the bays where the new boilers B-2 and B-3 will be located.
4. Infill bituminous paving between the garage doors and match to the slope of the concrete pads.
5. Install bituminous paving to 5 feet outside of concreted pads. Match to existing grade. See drawing C001 for site plan and detail.

C. HVAC Construction (.2) Contract:

1. Furnish and install new boilers B-2, B-3 and B-6 with associated piping, breeching, equipment, wiring, etc.
2. Furnish and install new combination deaerator and surge tank DA-2 with associated piping, pumps, wiring, etc. Existing DA tank will remain for backup.
3. Demolition of existing undersized flash tank. Furnish and install new appropriately sized flash tank with associated piping.
4. Furnish and install new steam meter on steam main in tunnel.
5. Demolition of existing boiler control panels. Furnish and install new boiler control panels.
6. Furnish and install new fuel oil piping for new boilers B-2, B-3 and B-6.
7. Furnish and install new steam flow meter, gas flow meter, oil flow meter and makeup water flow meter for each new boiler B-2, B-3 and B-6.

8. Furnish and install new steam flow meter and pressure transmitter in main steam line located in the tunnel.
9. Furnish and install secondary HPS line from steam header to connection point in basement. Secondary steam line will have shutoff valve. – **Base Bid 3**
10. Furnish and install emergency port connections form the steam system, gas and oil piping to termination point shown on drawings for emergency boiler. – **Base Bid 3**
11. Furnish and install new steam blowdown separator and associated piping. – **Base Bid 4**
12. Furnish and install new VFDs for sewer pumps in basement. – **Base Bid 4**
13. Furnish and install new VFDs for existing boiler feed pumps. – **Base Bid 4**
14. Furnish and install new dual fuel burner on existing boiler B-4 for gas and oil fired operation. – **Base Bid No. 5**
15. Demolish and remove existing fuel oil pump assembly. **– Base Bid 5**
16. Furnish and install new fuel oil pump assembly. **– Base Bid 5**

E. Electrical Construction (.4) Contract:

1. Furnish and install power to new boilers B-2, B-3, and B-6 with associated wiring and conduit.
2. Demolition of existing boiler control panels. Furnish and install power to new boiler control panels.
3. Furnish and install power to new rollup garage doors to serve new boilers B-2 and B-3.
4. Furnish and install an uninterruptible power supply (UPS) to back up the master control panel, boiler control panel, network computer system.
5. Demolition of existing motor control center (MCC) and extension of existing circuits to new panelboard and/or existing MCC that is to remain.
6. Demolition of existing substation switchboard. Furnish and install new substation switchboard, including extension of existing circuits previously fed from existing substation switchboard. – **Base Bid No. 2**
7. Demolition of existing substation transformer. Furnish and install new liquid filled substation transformer. – **Base Bid No. 2**
8. Furnish and install emergency port (fused disconnect switch) for temporary boiler. – **Base Bid No. 3**
9. Demolition of power to existing fuel pump assembly. Furnish and install power to new fuel pump assembly. – **Base Bid No. 4**
10. Demolition of existing fire alarm system. Furnish and install new fire alarm system. – **Base Bid No. 4**
11. Wiring and connections of new VFD's – **Base Bid No. 4**

1.6 SPECIFICATION FORMAT

A. The Specifications for the work of the separate prime Contracts are bound in one volume. Technical provisions which apply to each prime Contract are included in the Divisions listed below:

B. General Construction (.1) Contract: Divisions 01 through 14 and Divisions 31, 32 and applicable Sections of Division 33

C. HVAC Construction (.2) Contract: Divisions 01, 23 and applicable Sections of Divisions 02, 03, 05, 07, 09, 25, 31, 32 and 33.

D. Electrical Construction (.4) Contract: Divisions 01, 25, 26 and applicable Sections of 02, 03, 07, 08, 31, 32, and 33.

1.7 WORK BY OTHERS

A. Not applicable.

1.8 QUESTIONS DURING BIDDING PERIOD

A. Direct all questions pertaining to the Project to the Project Professional utilizing the e-Builder Enterprise Software Program (e-Builder) as described in the Instructions To Bidders.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 RECORD (AS-BUILT) DRAWINGS

A. The 0.1 General Contractor shall maintain a complete PDF set of the Contract Drawings at the site and shall record each deviation in his work (in red lines and text using mark-up software) from that indicated on the Contract Drawings. Deviations shall be clearly and accurately recorded so that the Professional can prepare final record (as-built) drawings using the 0.1 General Contractor's marked-up PDF's. Dimensions shall be recorded using permanent reference points such as columns, building walls and like items. These record drawings shall be submitted to e-Builder for review and approval by the Professional prior to final acceptance.

END OF SECTION 01 0100

SECTION 01 0250 - UNIT PRICES IN LUMP SUM CONTRACTS

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DEFINITIONS

A. Unit Price: An amount bid by the Contractor for a unit quantity of a work item listed in the Schedule of Unit Prices.

B. Schedule of Unit Prices: The schedule of work items in the Contract for which the Contractor is to provide a price for adjusting the Contract amount for changes in quantity of work required. The schedule also identifies the additional quantity for each item to be included in the lump sum base bid that is above and beyond the quantity identified elsewhere in the Contract Documents.

1.3 PROCEDURES

A. Unit Prices will be used as the basis for computing "additions to" the Lump Sum Contract amount for extra work and "deductions from" the Lump Sum Contract amount for reductions in quantities of work called for by the Contract Documents. The unit price applied for “Adds” to the bid quantity will be equal to the unit price applied for “Deducts” to the bid quantity for each item listed. Unit Prices shall remain binding and irrevocable for the entire period of the Contract.

B. Unit Prices shall include all costs by the Contractor, his suppliers and subcontractors for the work, including labor, material, tools, equipment, insurance, taxes, field overhead, general overhead and profit and bond. The work shall include all incidental items required to complete the work.

C. The Department will not be bound by the Unit Prices unless it accepts the same by indication on the Construction Contract. The Department may award the contract without accepting the bidder's Unit Prices. If the Department and the Contractor are unable to agree upon a new Unit Price, the Department may at its discretion, direct the Contractor to perform such work on a force account basis.

D. Work added to the Contract will be of the same general character as that required by the Contract Documents. Contractors are to assume that changes will be made in a timely manner, not requiring the Contractor to incur additional mobilization or other disproportional expenses in connection with the adjustment in contract quantities.

E. Each bidder shall carefully check the drawings and specifications for the Base Bid quantities required to be included under the Contract.

F. Contractors are to comply with the requirements of the Instructions to Bidders and instructions for completion of the Bid Form.

G. Contractors are to include the value of the additional quantity of each work item as separate line items on their Schedule of Values. Each line should include a description of the work item and include the term “Unit Price”.

1.4 SCHEDULE OF UNIT PRICES

The following Schedules of Unit Prices apply to the Contracts indicated on the Schedules. The Contractor is to provide Unit Prices for all items.

GENERAL CONSTRUCTION (.1) CONTRACT – SCHEDULE OF UNIT PRICES			
ITEM NO.	DESCRIPTION	UNIT OF MEASUREMENT	ADDITIONAL QUANTITY IN LUMP SUM BID
1	***Work activities that require paints that contain lead to be remove or are disturbed.***	358 Sq. Ft.	

HVAC CONSTRUCTION (.2) CONTRACT – SCHEDULE OF UNIT PRICES			
ITEM NO.	DESCRIPTION	UNIT OF MEASUREMENT	ADDITIONAL QUANTITY IN LUMP SUM BID
1	***Piping insulation that is removed, impacted, or damaged during renovations.***	125 LF	

ELECTRICAL (.4) CONTRACT – SCHEDULE OF UNIT PRICES - NOT USED

1.5 CHANGES

A. All changes in the quantity of work for which there is a Unit Price will be authorized using change order procedures provided in the General Conditions. Change Orders shall be written prior to performing the work where possible but may be written after the work is authorized, completed and measured when quantities are not able to be determined in advance.

1.6 MEASUREMENT

A. Measurement of the work quantities where the work is performed prior to issuance of a Change Order shall be net quantities and not include cutting waste or other adjustments to the unit of measure of the Unit Price. The Department and Contractor shall arrive at a rational procedure for measurement prior to performing the work. The Contractor shall be responsible for measurement and will submit the calculations and worksheets to the Department for approval.

1.7 DESCRIPTIONS OF UNIT PRICES

A. General Construction (.1) Contract:

1. Unit Price 1: ***Painted areas and surfaces containing "lead-base" or "leaded paint" that will be removed or are disturbed during construction.***

B. HVAC Construction (.2) Contract:

1. Unit Price 1: ***Piping insulation that is impacted during renovations must be removed and replaced. Contractor is responsible to provide on-site air monitoring and construction supervision.***

C. Electrical Construction (.4) Contract – Not Used

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 0250

SECTION 01 0300 - BASE BID DESCRIPTIONS

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. This Section includes identification of each Base Bid and description of the changes to be associated with each Base Bid.

1.3 DESCRIPTION OF SEPARATE BASE BIDS

A. GENERAL CONSTRUCTION CONTRACT (DGS C-0503-0027 PHASE 1.1)

1. Base Bid No. 1:

a. Demolition of existing walls. Furnish and install two new roll up doors for access and clearance of new boilers B-2 and B-3.
b. Demolition of existing walls. Furnish and install one new man door for egress.
c. Concrete and structural repair to the bays where the new boilers B-2 and B-3 will be located.
d. Infill bituminous paving between the garage doors and match to the slope of the concrete pads.
e. Install bituminous paving to 5 feet outside of concreted pads. Match to existing grade. See drawing C001 for site plan and detail.

2. Base Bid No. 2:

a. Same as Base Bid No. 1

3. Base Bid No. 3:

a. Same as Base Bid No. 2

4. Base Bid No. 4:

a. Same as Base Bid No. 3

5. Base Bid No. 5:

a. Same as Base Bid No. 4

B. HVAC CONSTRUCTION CONTRACT (DGS C-0503-0027 PHASE 1.2)

1. Base Bid No. 1:

a. Furnish and install new boilers B-2, B-3, and B-6 with associated piping, breeching, equipment, wiring, etc.
b. Furnish and install new combination deaerator and surge tank DA-2 with associated piping, pumps, wiring, etc. Existing DA tank will remain for backup.
c. Demolition of existing undersized flash tank. Furnish and install new appropriately sized flash tank with associated piping.
d. Furnish and install new steam meter on steam main in tunnel.

e. Demolition of existing boiler control panels. Furnish and install new boiler control panels.
f. Furnish and install new fuel oil piping for new boilers B-2, B-3 and B-6.
g. Furnish and install new steam flow meter, gas flow meter, oil flow meter and makeup water flow meter for each new boiler B-2, B-3 and B-6.
h. Furnish and install new steam flow meter and pressure transmitter in main steam line located in the tunnel.

2. Base Bid No. 2:

a. Same as Base Bid No. 1

3. Base Bid No. 3:

a. Same as Base Bid No. 2, except add:
b. Furnish and install secondary HPS line from steam header to connection point in basement. A shutoff valve shall be furnished and installed on the secondary steam line.
c. Furnish and install emergency port connections from the steam system, gas, and oil piping to termination point shown on drawings for the emergency boiler.

4. Base Bid No. 4:

a. Same as Base Bid No. 3, except add:
b. Furnish and install new steam blowdown separator and associated piping.
c. Furnish and install new VDFs for sewer pumps in basement.
d. Furnish and install new VDFs for existing boiler feed pumps.

5. Base Bid No. 5:

a. Same as Base Bid No. 4, except add:
b. Furnish and install new dual fuel burner on existing boiler B-4 for gas and oil fired operation.
c. Demolish and remove existing fuel oil pump assembly.
d. Furnish and install new fuel oil pump assembly.

C. ELECTRICAL CONSTRUCTION CONTRACT (DGS C-0503-0027 PHASE 1.4)

1. Base Bid No. 1:

a. Furnish and install power to new boilers B-2, B-3, and B-6 with associated wiring and conduit.
b. Demolition of existing boiler control panels. Furnish and install power to new boiler control panels.
c. Furnish and install power to new rollup garage doors to serve new boilers B-2 and B-3.
d. Furnish and install an uninterruptible power supply (UPS) to back up the master control panel, boiler control panel, network computer system.
e. Demolition of existing motor control center (MCC) and extension of existing circuits to new panelboard and/or existing MCC that is to remain.

2. Base Bid No. 2:

a. Same as Base Bid No. 1, except add:
b. Demolition of existing substation switchboard. Furnish and install new substation switchboard, including extension of existing circuits previously fed from existing substation switchboard.
c. Demolition of existing substation transformer. Furnish and install new liquid filled substation transformer.

3. Base Bid No. 3:

    a. Same as Base Bid No. 2, except add:
    b. Furnish and install emergency port (fused disconnect switch) for temporary boiler.

4. Base Bid No. 4:

    a. Same as Base Bid No. 3, except add:
    b. Demolition of power to existing fuel pump assembly. Furnish and install power to new fuel pump assembly.
    c. Demolition of existing fire alarm system. Furnish and install new fire alarm system.
    d. Wiring and connections of new VFD's.

5. Base Bid No. 5:

    a. Same as Base Bid No. 4

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 0300

SECTION 01 0400 - COORDINATION AND CONTROL

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. This section includes the on-site provisions that govern the performance of the work to complete this Project.

1.3 CONTRACTS - FOR THIS PROJECT CONSTRUCTION

A. DGS C-0503-0027 PHASE 1.1 General Construction

B. DGS C-0503-0027 PHASE 1.2 HVAC Construction (Lead Contractor)

C. DGS C-0503-0027 PHASE 1.4 Electrical Construction

1.4 VISIT TO SITE

A. Access to the facility during the bidding period will be restricted to a tour associated with the Pre-Bid Conference or other scheduled events.

1.5 UNIDENTIFIED HAZARDOUS MATERIALS (ASBESTOS, CHEMICALS, ETC.)

A. There is a possibility that hazardous materials not identified in the contract documents may be discovered on this project. Should it be determined that some or all of the hazardous materials must be removed, the Contractor shall obtain an estimate for said removal from a Subcontractor who is experienced in the field, has insurance and is knowledgeable of the regulations as they apply. The Contractor may provide the estimate itself if it is qualified in the applicable hazardous materials field. The Department shall consider authorizing a Change Order for the removal of the hazardous material to the extent necessary.

B. The Contractor or Subcontractor must comply with all requirements of the General Conditions, including the maintenance of insurance up to the limit required under the General Conditions.

C. Should a hazardous material be encountered on the job, the Contractor shall comply with all statutes and regulations of the Commonwealth of Pennsylvania and all rules and regulations of the United States Environmental Protection Agency as they apply during construction and demolition work and the disposal of hazardous material. Particular attention is drawn to Code of Federal Regulations, Title 40, Part 61, Section 112 of Clean Air Act and PA Department of Labor and Industry, Act 194 for asbestos.

D. The Contractor shall comply fully with the regulations of OSHA as they pertain to the protection of workers exposed to the emission of asbestos fibers, chemicals, etc. and shall take all steps necessary to protect its employees, as well as all other people occupying the building.

E. Whenever a hazardous material is to be removed or disposed of, the Contractor is required to make proper notification to the Bureau of Air Quality in the PA Department of Environmental Protections' Regional Office, PA Department of Labor and Industry and EPA as applicable, and is required to obtain and pay for any permits required. Disposal shall conform to all applicable regulations and documentation shall be required when, applicable.

1.6 LEAD PAINT

A. All work is to be performed with the assumption that all painted surfaces are lead containing. Each Prime Contractor is responsible for following all required OSHA 1926.62 'Lead In Construction' standards when disturbing or impacting these painted surfaces during the course of the renovations, including but not limited to activities such as: cutting and patching, core drilling, penetration, anchoring, fastening, etc. The area(s) shall be visually clean upon completion of any of these activities.

1. Action Plan: Contractor(s) shall submit an Action Plan that conforms to Paragraph 1.6.A.1-3 herein for approval at the Initial Job Conference, which specifically outlines details of means and methods to be used for each dust-generating activity involving lead-painted surfaces, erection of critical barriers and plastic sheeting for dust control, subsequent exposure assessment, personal protective equipment, hygiene and clean-up.
2. Contractor(s) shall utilize means and methods that preclude dust generation to complete work that disturbs/impacts lead-containing paint (i.e., paint stripper, HEPA-assisted drills, etc.).
3. Contractor(s) shall ensure areas beyond work area are not contaminated, and shall immediately stop work and erect plastic sheeting to prevent the spread of dust, anytime means and methods inadvertently create dust.

1.7 MOLD

A. In the event mold is encountered, the Contactor shall implement corrective actions to protect workers, other building occupants, and to prevent the disturbance of mold in affected areas. Although not presently regulated by EPA and/or OSHA, the EPA does provide industry standards regarding worker safety and abatement procedures, which are the minimum procedures to be followed if mold is encountered.

B. Any mold that appears as a result of construction shall be abated immediately by the Contractor responsible for this condition. The affected surface shall be cleaned, removed, and replaced. Inspection and testing shall be done by a qualified testing agency to confirm the mold has been removed in its entirety.

1.8 TESTING OF EQUIPMENT

A. After any equipment furnished under the contract and any permanent heating, ventilating, plumbing, drainage or electrical systems and equipment have been installed or modified, it shall be the responsibility of the Contractor to operate its equipment for a satisfactory period of time, as required by the Department for proper testing and instructing the operating personnel. Fuel, electricity and water required for proper testing of permanent equipment and for the period of instructing personnel, shall be paid for by the Contractor testing its equipment.

1.9 PROJECT PHOTOGRAPHS

A. Project Photographs not required.

1.10 INSTRUCTIONS AND TRAINING

A. Contractor shall utilize the Pre-Installation Meeting Agenda and Pre-Installation Meeting Checklist documents located in the e-Builder Z – Standard Documentation & Training project: Refer to the following Folder/sub-folders – Documents\03 – Construction – Training and Guidance Documents \ 03 – Role Based Training and Guidance Documents \ Contractors.

B. Refer to the General Conditions of the Construction Contract, as specified in the applicable technical portion of each specification for "Operations and Maintenance Instruction Manuals" and "Record Drawings" requirements.

C. Unless approved by the Department, training shall not be scheduled/conducted until Record Drawings, Operation and Maintenance Instruction Manuals, valve tag lists, equipment and piping system identification, and all software programming is complete.

D. Provide full on-site training and instruction to designated Commonwealth personnel given by competent manufacturer's authorized personnel thoroughly familiar with all technical and operational aspects of the installed items. Instructions are to cover operation and maintenance of all systems, equipment components and other items as specified and furnished under this contract. Instructional digital video recordings may be used to augment required instructions and training but may not be substituted for the in person on-site training. All on-site training shall be digitally recorded by the Contractor. The digital video files are to be turned over to the Client Agency.

E. Contractor shall provide an outline of the training and course content, which shall be submitted and accepted by the Professional and the Department prior to conducting training.

E. Conduct instruction and training during regular working hours. For training on complicated systems, allow at least one-half of the training time to be at and/or with the system equipment.

F. Provide additional training and instructions for all significant modifications and/or changes made under the terms and/or conditions of the manufacturer's and/or Contractor's warranty.

G. The Contractor shall maintain and submit a sign-in list that clearly documents all personnel attending the training.

1.11 REUSE OF MATERIALS

A. No removed materials or equipment shall be reinstalled in the work, unless so noted on the Drawing or in these Specifications.

1.12 GENERAL

A. All construction trailers, offices, equipment and materials required to be on-site shall be located as shown on the Drawings, or at the direction of the Department.

1.13 WORKING HOURS

A. The Contractor's available working hours shall be from __7___ A.M. to __5__ P.M., Monday through Friday.

B. Work during different hours, or work on Saturdays, Sundays, State and National Holidays or overtime work, must have the Regional Director's or his designee’s prior written approval. Work on these days if approved shall be at no additional cost or time to the Contract.

C. This shall not apply in those unforeseen isolated and/or emergency instances when a particular operation must be performed in a continuous sequence that extends the working day beyond the approved working hours. Coordinate with the Department in these instances.

D. The Department's failure to approve different working hours, weekend or holiday working hours, or overtime hours is not cause for a claim against the Department for delay or any added costs or time to the Contract.

E. Utility shut-downs required for tie-ins to existing systems shall be done in off-hours, weekends, and/or holidays to minimize the impact on the operations of the Client Agencies (and/ or surrounding buildings). These costs shall be anticipated and included in the Contractor’s bid. Contractor shall coordinate any utility shut-downs with the Client Agency Manager. Client Agency requires a minimum of one (1) week notice for any utility shut-down or service outage.

1.14 DELIVERY, STORAGE AND HANDLING

A. Prefinished materials shall arrive at job site in their original unopened cartons or other protective packaging necessary to protect finishes. Materials shall be stored in such packages until time of application. Flat materials such as panels shall arrive and remain on adequate support to ensure flatness and prevent damage.

B. Store all materials, equipment and bulk items prior to installation in clean, dry, well ventilated locations away from uncured concrete, masonry or damage of any kind. Waterproof tarpaulin or polyethylene sheeting must allow for air circulation under covering.

C. Coordinate storage location with the Department.

D. Refer to each section for specific delivery, handling and storage instructions of items specified.

1.15 PARKING

A. Parking shall be limited to areas indicated on the Site Plans. All parking is subject to prior approval of the Department and Client Agency.

1.16 TRAFFIC

A. The Lead Contractor shall establish at the Initial Job Conference a construction staging and traffic plan for the project which minimizes the construction interference with the Client Agency's operation. This plan is subject to the Department's and the Client Agency's review and acceptance. This acceptance does not relieve the Contractors of their responsibilities regarding safety coordination, and adherence to all traffic laws and ordinances.

1.17 SITE FENCE

A. A site fence is to be included when site conditions warrant, as determined by the Client Agency. Fences may be around the construction site, or just around the staging areas. In some cases, an inexpensive fence similar to a snow fence or plastic net is sufficient, other times a substantial wire or wooden fence is needed. Specify the required fence under this heading, and indicate location on drawings.

1.18 ENVIRONMENTAL QUALITY CONTROL

A. The Prime Contractor and its Subcontractors shall perform their work in a manner which shall minimize the possibility of air, water, land and noise pollution, in accordance with the General Conditions of the Construction Contract.

B. The name, address and telephone number of the Department of Environmental Protection Regional Office is furnished below. This office shall be contacted for waste disposal permits and for information concerning sites already approved for conducting waste disposal.

Northcentral Regional Office 208 West 3rd Street, Suite 101 Williamsport, Pa. 17701-6448 (570) 327-3636	Counties: Bradford, Cameron, Clearfield, Centre, Clinton, Columbia, Lycoming, Montour, Northumberland, Potter, Snyder, Sullivan, Tioga, and Union

1.19 OFFICE FOR CONTRACTOR

A. Each Prime Contractor shall provide and maintain, at its cost, a suitable office on the premises, at a location shown on the Lead Contractor's accepted staging plan. The Contractor shall provide and maintain heating facilities and supply fuel for same in cold weather and shall remove the office from the premises at completion of all work. Provide electrical, telephone and internet service.

1.20 DGS CONSTRUCTION MANAGER OFFICE

A. The Danville State Hospital is providing a space for the DGS Construction Manager Office. Therefore, no field office trailer will be required for this project.

B. Equipment: The Lead Contractor shall furnish, with the DGS Construction Manager Office, the following items in the quantity indicated and remove same from the premises when directed by the Department. The Lead Contractor shall maintain all items in good condition and furnish all supplies (i.e., toner, paper, bottled water, drinking cups, bathroom supplies) for the duration of the Contract. If any equipment fails, it shall be repaired or replaced by the Lead Contractor within twenty-four (24) hours of being notified by the Department.

The specified IT hardware/peripherals shall be compatible with the HP EliteBook 640 G9 or 650 G9 and include all required battery chargers, data cables (including HDMI), software, ect. to provide a fully integrated and functioning system.

1. _____ Desk(s) with swivel chair(s)
2. _____ Electronic calculator
3. _____ Plans rack(s), plan rack shall include required quantity of plan sticks to fully utilize the plan rack
4. _____ Plans table(s) with stools
5. _____ Four (4) drawer file cabinet(s)
6. _____ 12” deep shelving units of thirty (30) lineal feet
7. _____ Six (6) foot table(s)
8. _____ Chair(s)
9. _____ Clothes tree or closet with rod
10. __1__ Provide an all in one print/copy/scan/fax machine capable of producing 35 pages per minute double sided on 8-1/2"x11" and 11"x17". Machine shall be wireless capable and network capable and print/copy/scan/fax both in color and black and white
11. __3__ Safety glasses
12. __1__ Fire Extinguisher
13. __1__ First-Aid Kit
14. __1__ Water cooler, with hot and cold taps
15. _____ Telephones (cordless, with speaker phone capabilities), and answering machine.
16. _____ Trash cans

IT Hardware/Peripherals:

17. __4__ Computer monitor(s) - basis of design - Hewlett Packard ProDisplay M32FW FHD 32”
18. __2___ Keyboard - Wireless
19. __2___ Docking station with all associated cables for connection of all peripheral devices to support the Hewlett Packard Elitebook 640 G9 or 650 G9 - Basis of design - HP USB-C-G5 Docking Station.
20. __2___ Mouse – Wireless optical mouse with USB cord, dual button and scroll wheel – Basis of design - Hewlett Packard
21. __1___ 65” High-Definition LED Flat Panel Monitor will wall mount bracket. Remote control with batteries. Monitor will be network/Wireless Capable, 120Hz, 1080P.
22. _____ Wireless connectivity to the 55” High Definition LED flat panel monitor shall be accomplished with a wireless receiver and transmitter – Basis of design - ScreenBeam Mini2 wireless receiver (Catalog # SBWD60A01) and a ScreenBeam USB Transmitter 2 (Catalog # SBWD200TX02).
23. __1___ 4'x3' white marker board with (2) sets of markers of standard color.
24. __2___ 12 Month Wall Calendar - 20"x30" - Basis of design AT-A-GLANCE,Model #PM4-28-17

Other Items:

25. _____ Plain white ANSI approved hardhats

26. _____
27. _____
28. _____

C. The DGS Construction Manager Office shall be equipped by the Lead Contractor with telephone cabling and jacks to connect one (1) telephone voice line for use by DGS Personnel. The Lead Contractor shall provide up to four (4) modular telephone jacks (RJ11 connectors) in the main office area in locations indicated on the approved office plan accepted by the Department for use with the Contractor provided phones. The Lead Contractor will install telephone cable to connect each jack to the demarcation point where the local telephone company provides service (utility pole, telephone room or other access point). The Lead Contractor shall place orders to the local telephone company to activate line service and pay for the service and monthly charges.

1. The Lead Contractor shall provide three (3) data/phone jacks in locations indicated on the approved office plan accepted by the Department for use with the Department's computer(s) and Contractor provided phones. The Lead Contractor shall provide a Broadband Internet service and pay all connections/disconnection and monthly fees. The Lead Contractor shall further provide Wi-Fi access utilizing WPA2 security. Options include cable modem, DSL, Satellite or similar service (dial up is not acceptable). The wireless access point should be positioned to provide sufficient coverage in the DGS Construction Managers Office space. The contractor shall provide usernames/passwords for authorized wireless users as determined by the DGS Construction Project Manager.
2. It shall be the Lead Contractor's responsibility to ascertain the means in which the Broadband Internet source will be provided. Internet download and upload speeds of 500Mbs shall be provided at all times. The Internet source must be coordinated with the DGS Construction Project Manager to assure compatibility with the Department's hardware/software requirements. Wireless access point shall be made fully operational and maintained by the Contractor. At the Department's sole discretion 5G LTE wireless hotspot internet service and/or satellite internet service may be acceptable and/or necessary. Contractor shall be prepared to provide whichever methods provides the required internet download and upload speeds.
3. Location of the DGS Construction Manager Office shall be the **Montour Building #4 Second Floor, Office (Room #2021) and the Meeting Room will be the same room.**

1.21 SANITARY FACILITIES

A. The following conditions shall pertain:

1. Sanitary facilities will, within the limitations of the existing facilities, be provided by the Client Agency at no cost. The Lead Contractor shall provide all supplies and maintain the facilities in a clean and sanitary manner at all times.

2. The existing facilities available for the Contractor's use will be assigned by the Department at the Initial Job Conference.

1.22 SMOKING POLICY

A. Smoking and use of smokeless-tobacco, chewing tobacco, snuff, Vape machines and similar paraphernalia are strictly prohibited in all buildings.

1.23 CONCRETE AND EARTHWORK

A. All Contractors shall perform concrete work and earthwork required for their work, and shall comply with applicable Division 2, 3, 31, 32, and 33 sections. If any specification section contains language conflicting with requirements of applicable Division 2, 3, 31, 32, and 33 sections, the most stringent requirements shall prevail.

1.24 QUALITY CONTROL TESTING

A. Structural-related testing and inspections required to be performed by the Contractor(s) are listed in

Section 014000 – Quality Control Testing Services. If Quality Control testing or inspections required appear in Section 014000 and in a technical section, the most stringent requirements shall prevail. If Quality Control testing or inspections required appear in a technical section and not in Section 014000, they shall be required as if specified in Section 014000. Conditions pertaining to Quality Control testing and inspections may appear in the technical sections. All testing herein is to be by the Contractor. Testing by the Department, Quality Assurance Testing, is for the purpose of checking the results of the Contractor's Quality Control Testing. Testing is to be by the Contractor, unless specifically stated to be "by the Department" or required by Section 014010 – Quality Assurance Testing and Inspection Services.

B. Non-structural testing is in the technical specifications.

1.25 CADD FILE WAIVER

A. The Professional will make graphic portions of the bid drawings available for use by the Contractor by uploading files to e-Builder.

B. Electronic files shall be uploaded only after all construction contracts have been executed.

C. The files are provided as a convenience to the Contractor, for use in preparing shop drawings and/or coordination drawings related to the construction of this Project only. These files and the information contained within are the property of the Department and may not be reproduced or used in any format except in conjunction with this Project.

D. The Contractor acknowledges that the information provided in these files is not a substitution or replacement for the Contract Documents and does not become a Contract Document. The Contractor acknowledges that neither the Professional nor the Department warrant or make any representation that the information contained in these files reflect the Contract Documents in their entirety. The Contractor assumes full responsibility in the use of these files and acknowledges that all addenda, clarifications and changes to the drawings executed as a part of the Contract Documents may or may not be incorporated in these electronic files.

E. The Contractor acknowledges that the furnishing of these files in no way relieves the Contractor from the responsibility for the preparation of shop drawings or other schedules as set forth in the Contract between the Contractor and the Department.

F. The electronic documents shall be stripped of the Professional's name and address, and any professional licenses and signatures indicated on the contract documents. Use of these electronic documents is solely at the Contractor's risk, and shall in no way alter the Contractor's Contract for Construction.

G. Disclaimer: The Professional and Department make no representation regarding fitness for any particular purpose, or suitability for use with any software or hardware, and shall not be responsible or liable for errors, defects, inexactitudes, or anomalies in the data, information, or documents (including drawings and specifications) caused by the Professional's or its Consultant's computer software or hardware defects or errors; the Professional's or its Consultant's electronic or disk transmittal of data, information or documents; or the Professional's or its Consultant's reformatting or automated conversion of data, information or documents electronically or disk transmitted from the Professional's Consultants to the Professional.

H. By the Contractor's or their subcontractor's use of the electronic files (e.g., AutoCAD files), the Contractor and their subcontractor waive all claims against the Department the Professional, its employees, officers and Consultants for any and all damages, losses, or expenses the Contractor incurs from any defects or errors in the electronic documents. Furthermore, the Contractor shall indemnify, defend, and hold harmless the Department, the Professional, and its Consultants together with their respective employees and officers, from and against any claims, suits, demands, causes of action, losses, damages or expenses (including all attorney's fees and litigation expenses) attributed to errors or defects in data, information or documents, including drawings and specifications.

1.26 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where design services or certifications by a design professional are specifically delegated to the Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated in the technical specification sections.

1. If criteria indicated in the technical sections are not sufficient to perform services or certification required, submit a written request for additional information to the Professional.

B. Delegated Design Services Submittals: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional registered in the Commonwealth of Pennsylvania, for each product and system specifically assigned to the Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.27 COORDINATION DRAWINGS

A. Not Applicable.

1.28 PERMIT CONDITIONS

A. Boiler Intent to Install Permit. The HVAC contractor (.02) is required to submit and obtain a Boiler Intent to Install permit from the Pennsylvania Department of Labor and Industry for each unit that will be installed. A copy of the permit is located in the Specification Appendix.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 0400

SECTION 01 3100 - SEQUENCE OF CONSTRUCTION AND MILESTONES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 GENERAL REQUIREMENTS

A. Before beginning work, the Contractor will be required to prepare a schedule in consultation with the Department. The work must be carried out in full accordance with the schedule. The Contractor shall arrange to perform the work without any unnecessary interference with the Institution’s operation.

1.3 CRITICAL MATERIALS AND EQUIPMENT

A. The Contractor is cautioned that all necessary and required critical materials and equipment shall be ordered as quickly as possible, in order that the shipping will not delay the progress of the work or completion of the project.

1.4 CRITICAL ITEMS TO BE NOTED AS MILESTONES

A. Refer to the General Conditions, Article 8 ‘Project Schedule’, regarding construction progress Milestones to be established by the Lead Contractor.

B. The Contractor shall include the following critical items as Milestones:

1. General Construction (.1) Contract:

    a. Complete installation of 2 new roll up doors for access of new boilers.
    b. Complete installation of posts and footings required for B-2
    c. Complete installation of framework, posts and footings for B-3.
    d. Complete installation of posts and footings required for B-6.
    e. Complete installation of posts and footings for deaerator tank.
    f. Complete in-fill for B-2
    g. Complete in-fill for B-3.

2. HVAC Construction (.2) Contract:

    a. Complete installation of steam, condensate, and boiler feedwater piping.
    b. Pressure testing of steam, condensate, and boiler feedwater piping.
    c. Complete installation of boiler B-2.
    d. Complete installation of boiler B-3.
    e. Complete installation of boiler B-6.
    f. Pressure testing of new boilers B-2, B-3, and B-6.
    g. Boiler start-up for new boilers B-2, B-3, and B-6.
    h. Complete installation of new dual compartment Deaerator DA-2 with associated boiler feedwater and condensate transfer pumps.

3. Electrical Construction (.4) Contract:

    a. Complete installation of new electrical substation switchboard, including concrete pad.
    b. Complete installation of exterior pad mount transformer, including concrete pad, conduit, and conductor runs.
    c. Complete installation of electrical rough-in of raceways, backboxes, and connections for mechanical equipment connections.

d. Complete installation of electrical rough-in of raceways, backboxes, and connections for new fire alarm system.

1.5 SEQUENCING OF CONSTRUCTION AND OTHER REQUIREMENTS

A. When the Work of this Project includes longer than industry standard lead-times for materials or equipment for which all other tasks on the Project Schedule become dependent, the Department may issue a notice of a temporary suspension of the Work. If temporarily suspended, the Contractor must notify the Department at least thirty (30) days prior to the delivery date of the materials or equipment. Upon such notice, the Department will terminate the suspension and direct resumption of the Work to occur on or about the delivery date. The Contractor, in consultation with the Department, will evaluate the length of time needed to complete the project and a non-compensatory Extension of Time Change Order may be submitted by the Prime Contractor(s), which the Department will review in accordance with the Administrative Procedures governing Extensions of Time. During the temporary suspension, the Contractor will be responsible to maintain all installed temporary facilities.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 3100

SECTION 014000 - QUALITY CONTROL TESTING SERVICES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections, "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 GENERAL

A. The Contractor is responsible for verifying and enforcing compliance with all requirements of the Contract Documents. Contractor's responsibility includes, but is not limited to, the following:

1. Supervision of field work to enforce contract compliance of all construction activity.
2. Verification of compliance with plans and specifications of all manufactured materials or equipment. Provide certificates of compliance, or other approved proof of compliance, by the manufacturers and submit to the Professional.
3. Performance of all necessary field measurements and/or inspections to verify compliance with requirements of the plans or specifications requiring adherence to measurable standards of field performance.
4. Engaging an independent testing laboratory to perform tests and inspections as required by this specification section, hereafter referred to as Quality Control Testing and Inspection Services or Quality Control Testing Services.
5. Providing support services for all Quality Control Services, including cutting and patching and repair or replacement as required.

B. Work not included: Quality Assurance Services by the Department are specified in Section 014010. The Department reserves the right to perform tests under the Quality Assurance Testing program and to use those as the basis for approval or rejection at its sole discretion.

1.3 DESCRIPTION OF QUALITY CONTROL TESTING

A. Quality Control Services include inspections, tests and reports by an independent testing laboratory or other approved agency, hereafter referred to as the Quality Control Agency. All Quality Control Services shall be at the Contractor's cost, which shall be included proportionally in all items of payment or contained in any Base Bid or Unit Price on the Proposal. Tests and Inspections are to include those specifically required by this section and within technical sections of the Project Manual.

B. The Quality Control Agent shall submit a Testing and Inspection Plan to the Professional for its approval, and the approval of the Quality Assurance agent for all tests and inspections required by this section and within technical sections of the Project Manual.

C. Quality Control Services by a Quality Control Agency or Agencies is intended to assist in the determination of probable compliance of the work with requirements specified or indicated and do not relieve the Contractor of the responsibility for compliance with Contract Document requirements.

D. Specific testing or inspections of a structural nature required to be performed by independent Quality Control Agencies for individual construction activities are specified in this Section only. If testing or inspection requirements appear in this section and a technical section, the most stringent requirements shall prevail. If Quality Control Testing or Inspection is specified in a technical section and not in this section, it shall be required as if specified in this section. Non-structural tests and inspections are in the technical specifications.

E. Inspections, tests and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Documents requirements.

F. Quality Control Services required by the local municipality or other governing authorities are the responsibility of the Contractor, regardless of whether or not specified hereinafter or in the applicable specification section.

G. Each prime Contractor will pay for all costs in connection with its Quality Control Services. Whenever the word "Contractor" is used it shall be interpreted to mean Prime Contractor or Contractors as applicable. All Contractors performing work for which testing or inspection is required by this section are required to perform said tests/inspections appropriate for the quantity of work performed as indicated by this specification section and as required by all Contract Documents.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 RESPONSIBILITIES AND DUTIES OF CONTRACTOR

A. The Contractor shall engage Quality Control Agencies to provide all Quality Control Services required to comply with the Contract Documents. These services shall be at no cost to the Department.

B. The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and indicate non-compliance with Contract Document requirements. Likewise, the Contractor is responsible for retesting when the Department's Quality Assurance Test results prove unsatisfactory. If Quality Assurance Tests were in error, the Contractor shall be reimbursed for his retesting costs.

C. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility.

D. Provide the Quality Control Agency with preliminary representative samples of materials to be tested in quantities requested. If the source, quality or characteristics of an approved material changes or indicates lack of compliance with Contract requirements, submit additional samples of materials to the Quality Control Agency.

E. When requested by the Professional, the Department, or the Quality Control Agency, the Contractor shall immediately provide reports, cutting lists, material bills, shipping bills, time and place of shipment of materials to shop and field and any relevant data on previous testing and investigations of materials.

F. Provide casual labor and facilities:

1. To provide access to the work inspected or tested by any authorized party.
2. To obtain and handle samples at the site.
3. To facilitate inspections and tests by the Quality Control Agency or Quality Assurance Agency.
4. For security and protection of samples and test equipment at the project site.

G. To facilitate the timely sequence of inspection and testing, the Contractor shall give advanced notification to the Quality Control Agency and the Department that work has progressed to a point where inspection and testing may proceed.

H. Contractor shall pay for additional cost of Quality Control Agency services which, in the opinion of the Professional and the Department, are required because of the following:

1. Failure of materials or workmanship to meet Contract requirements.

2. Materials or practices not complying with the technical specifications which could possibly result in defective and unacceptable work.
3. Changes in source, quality or characteristics of materials.
4. Site cured concrete cylinders requested by the Contractor.

I. The Quality Control Agency shall submit a certified written report of each inspection, test or similar service to the Design Professional, the Quality Assurance Agent, the Bureau of Construction Regional Director, Project Manager and Assistant Project Manager, and the Contractor, with additional copies directly to any governing authority when that authority so directs. All reports shall be uploader to e-Builder within 24 hours of when the inspection occurs, test is conducted, test results obtained or similar service was conducted.

J. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:

1. Date of issue.
2. Project title and number.
3. Name, address and telephone number of testing agency.
4. Dates and location of samples and tests or inspections.
5. Names of individuals making the inspection or test.
6. Designation of the Work and test method.
7. Identification of product and specification section.
8. Complete inspection or test data.
9. Test results and an interpretation of test results.
10. Ambient conditions at the time of sample taking and testing.
11. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.
12. Name and signature of Quality Control Agency inspector.

K. The QC Agent shall cooperate in using standard forms/procedures developed by the Department that assist in accomplishing the tasks required.

L. Engage independent testing laboratories, whose employees assigned to the Project and tests performed comply with ASTM E 329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction. The testing laboratory must be accredited and audited by a qualified national authority. The Contractor is to submit the name and credentials of the proposed QC Agent through e-builder to the Design Professional and the Department for acceptance.

M. Upon completion of inspection, testing, sample taking and similar activities, repair the damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed finishes. Comply with the Contract Document requirements for "Cutting and Patching". Protect work exposed by or for Quality Control Testing activities, and protect repaired work.

N. All required testing/inspection, including that stated in the body of the technical specification sections (be it referenced in the technical specifications as “Quality Control”, “Quality Assurance”, or any other referenced testing and/or inspection) shall be performed by the Contractor, unless it explicitly states it shall be performed by the Department. If stated to be performed by the Department, the Contractor shall still be required to perform all necessary testing/inspection in advance of the Department to assure the work meets all the requirement of the contract documents.

O. Contractor shall coordinate closely with the Department, the Professional and the Professional’s QA Agencies and Consultants so that any required or desired QA testing can be performed concurrently or immediately after the Contractor’s QC testing.

3.2 RESPONSIBILITIES AND DUTIES OF QUALITY CONTROL AGENCIES

A. Quality Control Agencies engaged to perform inspections, sampling and testing of materials and construction shall cooperate with the Professional, the Quality Assurance Agent, the Department, the Department of Labor and Industry, and the Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests. If it is determined by the Department that the personnel provided are not qualified or are not working in the best interests of the Project for the tests performed, the Contractor, through their Quality Control Agent, shall immediately replace or supplement the subject personnel.

B. Quality Control Agencies shall notify the Department, the Quality Assurance Agent, the Professional, and the Contractor immediately of irregularities or deficiencies observed in the Work during performance of its services.

3.3 QUALITY CONTROL SERVICES TO BE PERFORMED

A. Testing and inspections by the Quality Control Agency or Agencies shall include, but are not limited to, the following list.

LIST OF TESTS AND INSPECTIONS

DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	QUANTITY OR FREQUENCY
BITUMINOUS PAVEMENT		
Bulk Specific Gravity…of Compacted Bituminous Mixtures…	ASTM D1188 or D 2726	1 test
Density of Bituminous Concrete in Place by Nuclear Method	ASTM D2950	6 tests/1000sy paving
Thickness or Height of Compacted Bituminous Paving Mixture Specimens	ASTM D3549	3 tests/1000sy paving
EARTHWORK[1]		
Laboratory Compaction Characteristics of Soil Using Modified Effort	ASTM D1557	One for each type and variation of cohesive soil to be compacted
Laboratory Compaction Characteristics of Soil Using Standard Effort	ASTM D698	One for each type and variation of cohesive soil to be compacted
Density of Soil and Soil-Aggregate In Place by Nuclear Methods	ASTM D6938	As often as required to ensure contract compliance
Inspect and comment on suitability of subgrades. Test footing excavations and paving subgrades regardless if it is native material or fill and record resultant foundation bearing capacity or compaction results as applicable.	N/A	As often as required to ensure the minimum required bearing capacity is present. Bearing Capacity tests must be witnessed and/or reviewed by the Department, Professional, Professional's Geotechnical Engineer or QA Agent.

DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	QUANTITY OR FREQUENCY
Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	ASTM D6938	Continuous
CONCRETE		
Practice for Sampling Freshly Mixed Concrete. (5 cylinders/test) Perform air tests when sampling concrete. Perform slump tests and record temperature for all concrete deliveries. Compressive Strength of Cylindrical Concrete Specimens	ASTM C143, C1064, C231 or C173 or C138, C172, C31 C39	For each mix, 1 test for each day of concreting or for each 50cy, whichever is greater. For non-structural concrete, 1 test for each 100cy is adequate.
Inspection of bolts to be installed in concrete prior to and during placement of concrete, where allowable loads have been increased or where strength design is used	AWS D1.4; ACI 318: 3.5.2	
Inspection of concrete placement for proper application techniques	ACI 318: 5.9, 5.10	Continuous
Verification of slump flow and VSI as delivered to the site for self-consolidating grout	ACI 530	Continuous
MASONRY		
Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry (3 prisms/test)	ASTM C1314	1 Test
Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry, Annex A7 Compressive Strength (3 cylinders/test) (Contractor makes cylinders.)	ASTM C 780	1 Test/5000 units of masonry for each mortar type.
Sampling and Testing Grout (3 cubes/test) (Contractor makes cubes)	ASTM C1019	1 Test/25 CY grout.
Observation of any grout specimens and/or prisms	ACI 30.1/ASCE 6/TMS 602 Art 1.4	Continuous
STRUCTURAL STEEL		
High Strength Bolting	AISC ASD or LRFD M2.5	Comply with current requirements of RCSC
Liquid Penetrant Examination	ASTM E165	Test 15% of critical field welds using ultrasonic examination method
Guide for Magnetic Particle Examination	*ASTM E709*	
Practice for Ultrasonic Contact Examination of Weldments	ASTM E164	
Guide for Radiographic Examination	ASTM E94	

Footnotes:

1. Refer to Earthwork Section for additional details.

END OF SECTION 01 4000

SECTION 01 4010 - QUALITY ASSURANCE TESTING AND INSPECTION SERVICES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 GENERAL

A. All testing and inspecting specifically called for and/or described in this section of the specifications are referred to as Quality Assurance Services and are the responsibility of the Quality Assurance Agency. Except as hereinafter specified, Quality Assurance Services will be performed without expense to the Contractor. The Quality Assurance Agency is an independent testing and inspecting agency engaged by the Department through the Professional. Testing required because of changes in materials or proportions at the request of the Contractor shall be at the Contractor's expense. The Professional may engage more than one Quality Assurance Agency to perform services. Whenever the word "Contractor" is used it shall be interpreted to mean Prime Contractor or Contractors as applicable.

B. Work Not Included: Quality Control Testing to be performed by the Contractor is specified in Section 014000.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 RESPONSIBILITIES AND DUTIES OF THE CONTRACTOR

A. The use of Quality Assurance Services shall in no way relieve the Contractor of its responsibility to furnish materials and construction in full compliance with the plans and specifications or to perform Quality Control Testing where specified.

B. To facilitate Quality Assurance Inspection or Testing, the Contractor shall:

1. Secure and deliver to the project site, without cost, representative samples of materials it proposes to use and which are required to be tested under Paragraph 3.4, ‘Tests and Inspections’.
2. Furnish such casual labor as is necessary to obtain and handle samples at the project or at other sources of material.
3. Provide means of safe access to work areas, provide conditions that allow testing and inspection to take place, provide materials for testing as requested, patch test sites when completed and furnish incidental labor and assistance necessary for inspectors of the Quality Assurance Agency to perform their tests and inspections.

3.2 AUTHORITY AND LIMITATIONS OF QUALITY ASSURANCE AGENCY

A. Personnel representing the Quality Assurance Agency will not act as foremen nor perform other duties for the Contractor.

B. Work will be checked as it progresses, but failure to detect any defective work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Department or the Professional for final acceptance.

C. The Quality Assurance Agency is not authorized to revoke, alter, relax, enlarge, or release any requirements of the specifications, nor to approve or accept any portion of the work.

D. The Quality Assurance Agency shall report all test and inspection results to the Professional, the Department and the Contractor immediately after they are performed. Selection and frequency of tests shall be at the discretion of the Professional and the Department. All reports shall be uploader to e-Builder within 24 hours of when the inspection occurs, test is conducted, test results obtained or similar service was conducted.

E. Written reports of each inspection, test or similar service shall include but not be limited to:

1. Date of issue.
2. Project title and number.
3. Name, address and telephone number of testing agency.
4. Dates and location of samples and tests or inspections.
5. Names of individuals making the inspection or test.
6. Designation of the Work and test method.
7. Identification of product and specification section.
8. Complete inspection or test data.
9. Test results and an interpretation of test results.
10. Ambient conditions at the time of sample taking and testing.
11. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.
12. Name and signature of Quality Control Agency inspector.

F. When it appears that any material furnished or work performed by the Contractor fails to fulfill contract requirements, the Quality Assurance Agency shall report such deficiency to the Professional, the Department and the Contractor.

3.3 CONTRACTOR'S FAILURE TO MEET CONTRACT REQUIREMENTS

A. The Department and the Professional reserve the right to reject any items which do not meet the requirements of the plans and specifications and will require the contractor to replace these items and bear all expenses in connection with such replacements.

B. The Contractor shall pay all costs incurred in providing additional testing and/or analysis (including engineering fees) required because of deficient test results or construction not in compliance with requirements of the Contract Documents.

3.4 TESTS AND INSPECTIONS

A. Tests and inspections listed below may, at the discretion of the Professional and the Department, be performed by an independent Quality Assurance Agency engaged by the Department through the Professional, without expense to the Contractor. The Department reserves the right to change this list at any time.

SECTION 1

REQ'D BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
	BITUMINOUS PAVING		
DGS	Field inspection of construction procedures		
DGS	Bulk Specific Gravity…of Compacted Bituminous Mixtures…	ASTM D1188 or D 2726	
DGS	Density of Bituminous Concrete in Place by Nuclear Method	ASTM D 2950	
DGS	Thickness or Height of Compacted Bituminous Paving Mixture Specimens	ASTM D 3549	
	CONCRETE		
IBC	1. Inspection of reinforcing steel and placement	ACI 318: Ch. 20, 25.2, 25.3, 26.6.1-26.6.3	1908.4
IBC	2. Inspection of bolts to be installed in concrete prior to and during placement of concrete, where allowable loads have been increased or where strength design is used	ACI 318: 17.8.2	–
IBC	3. Inspection of anchors installed in hardened concrete	ACI 318: 17.8.2	–
IBC	4. Verifying use of required design mix	ACI 318: Ch. 19, 26.4.3, 26.4.4	1904.1, 1904.2, 1908.2, 1908.3
IBC	5. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, determine the temperature of the concrete	ASTM C172, C31; ACI 318: 26.2, 26.12	1908.10
IBC	6. Inspection of concrete placement for proper application techniques	ACI 318: 5.9, 5.10	1908.6, 1908.7, 1908.8
IBC	7. Inspection for maintenance of specified curing temperature and techniques	ACI 318: 26.5.3-26.5.5	1908.9
IBC	8. Inspect formwork for shape, location and dimensions of the concrete member being formed.	ACI 318:26.11.1.2 (b)	–
DGS	Review Contractors' design mixes, Certificates of Compliance and material test reports		
DGS	Compressive Strength of Cylindrical Concrete Specimens[2]	ASTM C39	
	MASONRY		
DGS	Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry, Annex A7 Compressive Strength[6]	ASTM C780	
DGS	Method of Sampling and Testing Grout[6]	ASTM C1019	

	Level 1 Special Inspection		
IBC	1. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified.	Art. 1.5[5]	
IBC	2. Verification of f'_m and f'_{AAC} prior to construction except where specifically exempted by this code.	Art. 1.4B[5]	
IBC	3. Verification of slump flow and VSI as delivered to the site for self-consolidating grout.	Art. 1.5B.1.b.3[5]	
IBC	4. As masonry construction begins, the following shall be verified to ensure compliance: a. Proportions of site-prepared mortar b. Construction of mortar joint c. Location of reinforcement connectors, prestressing tendons and anchorages d. Prestressing technique e. Grade and size of prestressing tendons and anchorages	 Art 2.1, 2.6A[5] Art 3.3B[5] Art 3.4, 3.6A[5] Art 3.6B[5] Art 2.4B, 2.4H[5]	
IBC	5. The inspection program shall verify: a. Size and location of structural elements b. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction. c. Specified size, grade and type of reinforcement, anchor bolts, prestressing tendons and anchorages. d. Preparation, construction and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F) e. Application and measurement of prestressing force	 Art 3.3F[5] Sec 1.16.4.3[4], 1.17.1[4] Sec 1.16[4], Art 2.4, 3.4[5] Art 1.8C, 1.8D[5] Art 3.6B[5]	
IBC	6. Prior to grouting, the following shall be verified to ensure compliance: a. Grout space is clean b. Placement of reinforcement and connectors and prestressing tendons and anchorages c. Proportions of site-prepared grout and prestressing grout for bonded tendons d. Construction of mortar joints	 Art 3.2D[5] Sec 1.13[4], Art 3.4[5] Art 2.6B[5] Art 3.3B[5]	
IBC	7. Grout placement shall be verified to ensure compliance with code and construction document provisions	Art 3.5[5]	
IBC	8. Preparation of any required grout specimens, mortar specimens and/or prisms shall be observed	Art 1.4 B.2.a.3, 1.4 B.2.b.3, 1.4 B.2.c.3, 1.4 B.3, 1.4 B.4[5]	
	STEEL CONSTRUCTION		
IBC	1. Material verification of high-strength bolts, nuts, and washers: a. Identification markings to conform to ASTM standards spec in the approved CDs. b. Manufacturer's Certificate of Compliance required	AISC Material Specifications: AISC 360-16, Section A3.3	1705.2.1

IBC	2. Inspection of high-strength bolting: a. Snug-tight joints	RCSC Specification for Structural Joints using ASTM A325 or A490 Bolts-Section 9.1	1705.2.1
IBC	3. Material verification of structural steel and cold-formed steel deck: a. For structural steel, identification markings to conform to AISC 360 b. For other steel, identification markings to conform to ASTM standards specified in the approved CDs c. Manufacturer certified test reports	AISC 360-16 Section A1.1	1705.2.1
IBC	4. Material verification of weld filler materials: a. Identification markings to conform to AWS specification in the approved CDs b. Manufacturer's Certificate of Compliance required	AISC 360-16 Table N5.4-1,	1705.2.1
IBC	5. Inspection of welding: a. Structural steel 1) Complete and partial penetration groove welds 2) Multi-Pass fillet welds 3) Single-pass fillet welds > 5/16" 4) Plug and slot welds 5) Floor and deck welds	AWS D1.1 AWS D1.3	1705.2.1 1705.2.1
IBC	6. Inspection of steel frame joint details for compliance with approved CDs: a. Details such as bracing and stiffening b. Member locations c. Application of joint details at each connection		1705.2.1
DGS	Liquid Penetrant Examination	ASTM E165	
DGS	Guide for Magnetic Particle Examination	ASTM E709	
DGS	Practice for Ultrasonic Contact Examination of Weldments	ASTM E164	
DGS	Guide for Radiographic Examination	ASTM E94	
	GENERAL OVERVIEW OF QC TESTING		
DGS	Review of Contractor QC Testing and Reports		

SECTION 2

REQD BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
	SOILS		
IBC	1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity		1704.7
IBC	2. Verify excavations are extended to proper depth and have reached proper material		1704.7
	ENGINEERING SERVICES		
DGS	Review of Contractor QC Test Reports.		
DGS	Review of Contractor QC Soil Bearing Test Reports.		
DGS	On-site Engineering Consultation[7]		
DGS	Office Engineering Consultation[7]		

Footnotes:

1. "DGS" are tests required by DGS and "IBC" are test required by Chapter 17 of the 2009 International Building Code.
2. IBC 2018.
3. Not used.
4. Refers to reference ACI 530/ASCE 5/TMS 402.
5. Refers to reference ACI 530.1/ASCE 6/TMS 602.
6. Concrete, mortar or grout molds are to be made by QA Agent under Special Inspection hours.
7. Principal(s) shall be Registered Professional Engineer(s). The Engineer making decisions and recommendations shall be a Registered Pennsylvania Professional Engineer.

END OF SECTION 01 4010

SECTION 01 5000 - TEMPORARY UTILITIES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 TEMPORARY SERVICES DURING CONSTRUCTION

A. The designated Contractor shall install, operate, protect and maintain the temporary services, as hereinafter specified, during the construction of the entire Project.

B. Temporary connections to new and/or existing permanent service lines shall be made at the appropriate locations as determined by the designated Contractor, and coordinated with the Department, in conjunction with the Client Agency (as applicable). When the temporary service lines are no longer required, they shall be removed by the Contractor. Any part or parts of the permanent service lines, grounds and building, disturbed and damaged by the installation and/or removal of the temporary service lines, shall be restored to their original condition by the Contractor responsible for the temporary installation.

C. If the Contractor fails to carry out its responsibility in supplying temporary services as set forth in this Contract, it is responsible for such failure, and the Department may take such action as it deems proper for the protection and conduct of the work, and shall deduct the cost involved from the amount due the Contractor. Only those temporary utilities required for construction need to be extended to the work area(s).

D. Temporary utilities for Prime Contractors’ office trailers shall be arranged and paid for by each responsible Prime Contractor. The Lead Contractor shall arrange, provide, install, and pay for all temporary utilities required for the DGS Construction Project Manager’s office/ trailer.

1.3 TEMPORARY WATER SUPPLY

A. The Mechanical Contractor shall install, operate, protect and maintain an adequate water supply during the period of construction, either by means of the permanent water supply line, or by the installation of a temporary water supply. The temporary water supply shall be in place within fifteen (15) days of any Prime Contractor’s written request for such services.

B. The Lead Contractor shall pay all charges for water consumption, except for testing, as specified in Section 010400.

1.4 CONSTRUCTION LIGHT AND POWER

A. The Electrical Contractor shall install, operate, protect and maintain the temporary service for construction light and power. The Contractor shall extend the temporary wiring throughout the project work areas, properly insulated and installed in accordance with Article 300 of the National Electrical Code. All wiring shall be installed by a licensed electrician.

B. The Electrical Contractor shall furnish this service within fifteen (15) days of any Prime Contractor’s written request for such services. The service shall be sized to satisfy project requirements, but shall not be less than 200 amp, single-phase, 3-wire 120/240 volts, with fused safety switch protection required. Additional capacity in the form of other independent services and panels shall be provided as needed at required location throughout the site to meet the requirements of this section.

C. The Electrical Contractor shall extend electrical wiring into the building to provide adequate light and power, for the proper execution of the work. The Electrical Contractor shall also provide three-phase, 208 volt power service, if required. As construction progresses, it shall extend the temporary services to all areas where required, with a minimum of 100W incandescent equivalent light and duplex power outlets at 20 feet on center minimum, and at least in every room or space. The maximum size motor to be used at any power service shall be limited to 5 hp. Construction light and power provided shall fully comply with all provisions for this service of the National Electric Code and OSHA.

D. Where a service of a type other than that as herein mentioned is required, each Contractor requiring same shall provide such service and necessary equipment at its own expense.

E. The Electrical Contractor, prior to the installation of the permanent service, shall provide portable generators or shall extend a temporary service line to the site, and shall sign for the meter and pay all electrical connection costs.

F. The Electrical Contractor shall provide all transformers necessary to provide temporary power.

G. The Electrical Contractor shall provide all meters and/or submeters required and necessary to meter usage.

H. The Lead Contractor shall pay all electric consumption and associated costs for its use and that of all Prime Contractors, until Closeout Inspection occurs, and all items of work are certified to be complete.

1.5 WELDING

A. Any Contractor using electrical power for welding on the site shall use self-contained engine generating units.

B. Each Contractor shall provide necessary exhaust/ventilation/filtration to prevent accumulation of welding fumes and smoke generated by welding their operations.

C. Each Contractor shall have all precautions and protection in place while welding to assure no sparks cause fire or smoke damage to all surrounding areas; during and after all welding activities.

1.6 FIRE EXTINGUISHERS

A. Each Contractor shall provide UL listed, NFPA approved fire extinguishers, ten (10) lb. minimum, at the construction site during operations, suitable for all types of fires in accordance with OSHA.

1.7 INTERRUPTION OF SERVICES

A. Each Prime Contractor shall have all needed equipment and material to complete planned work at the site, prior to shutting down any system.

B. No additional compensation or time will be given to the Contractor, if work must be performed on State or National Holidays or on weekends or on overtime. See paragraph on ‘Working Hours’ under Section 010400.

1.8 SNOW/ICE REMOVAL

A. The Lead Contractor shall be responsible to provide snow removal and anti-skid material into to site and at the project site and indicated laydown areas (including construction trailer), unless directed otherwise.

B. All related work shall be performed to provide proper and safe access throughout the site subsequent to each related work day. Any delay and potential related costs generated by failure to meet this requirement shall be the responsibility of the Lead Contractor.

1.9 DEWATERING

A. Each Prime Contractor shall provide adequate attention, equipment and manpower to the project to assure the work area is dewatered as required to eliminate ponding, excessive water, depressions, etc. as affected by and for their work activities. Such action shall occur no later than 24 hours after a rain or water producing event. This effort shall be sustained for the time period necessary to bring the affected area back into conformance.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 5000

SECTION 01 6150 - DEPARTMENT OF HUMAN SERVICES – SUPPLEMENTAL PROVISIONS

CONTRACTOR BEHAVIOR AND ACTIVITIES AT DEPARTMENT OF HUMAN SERVICES YOUTH DEVELOPMENT CENTERS, SECURE TREATMENT UNITS, YOUTH FORESTRY CAMPS, MENTAL HEALTH AND STATE CENTERS

PART 1 – GENERAL

1.1 STIPULATIONS

A. The Specifications Sections, " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements", form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 PERSONAL BEHAVIOR

A. Contractors are responsible for disseminating to their employees the special restrictions on personal behavior and the procedures/potential penalties for violations.

B. Identification tags or badges to be furnished by the facility must be worn at all times while on facility property.

C. Smoking, vaping and tobacco products are not permitted in any facility building. Tobacco may be used only in designated areas.

1.3 VEHICLES

A. Construction vehicles and employee's vehicles will be parked in an area designated by the Department and locked at all times. The license numbers of vehicles to be left overnight will be reported to the security office at the facility on a daily basis by the Contractors.

B. Vehicles may not be operated or parked on any lawn areas, unless otherwise permitted.

1.4 TOOLS

A. Tools shall be kept in a secure (locked) area when not in use and inventoried to insure complete and total accountability at the end of each shift. While being used, tools shall be kept in view or on person. Broken or non-usable tools are to be disposed of away from the facility property. Any missing tools are to be reported promptly to the Facility Maintenance Manager. Particular attention should be paid to tools, which may be used as weapons or instruments of escape. Special procedures will be developed with the facility's Maintenance/Engineering Department concerning cutting pliers, bolt cutters, hacksaws and welding or cutting equipment. UNDER NO CIRCUMSTANCES WILL CUTTING TORCHES OR WELDING EQUIPMENT BE LEFT INSIDE THE PERIMETER SECURITY ENCLOSURE (at facilities with enclosures) OVERNIGHT, ON WEEKENDS OR ON HOLIDAYS.

B. Any trash or garbage that could present a health or safety risk to residents or staff must be safely disposed of by the Contractors. This includes, but is not limited to, nails, screws, metal material, etc.

C. No ladders may be left upright and accessible to residents. If not in use, ladders must be taken down and secured. Scaffolding must be secured to guard against unauthorized use.

1.5 WORK AREAS

A. All work areas are to be kept safe and orderly at all times.

B. All doors are to be kept locked to ensure resident safety. Doors normally unlocked are excluded, unless safety becomes an issue.

C. Passenger elevators are not to be used to transport materials, unless written authorization is given specifying dates and times when it is permissible.

D. Flammable liquids are not to be stored inside occupied buildings.

E. Do not compromise Life Safety Code requirements without prior written consent of the facility's Safety Manager, who will develop and implement alternate plans.

F. Facility supplies are not to be utilized by Contractors, unless they are specifically spelled out in the Project Specifications.

G. Contractors are to be aware of the locations of fire alarms, fire extinguishers and related equipment. The facility Fire Marshal is available to instruct the Contractors in the proper operation of fire safety equipment.

1.6 FRATERNIZATION

A. There shall be no fraternization or private relationships of Contractors' employees with residents. This includes, but is not limited to trading, bartering or receiving gifts, money, or favors from the residents or the residents' friends, relatives or representatives.

B. In accordance with its zero tolerance policy, the Department prohibits all forms of sexual abuse and sexual harassment of juvenile in its facilities. The Contractor will comply with Department policy and with the Prison Rape Elimination Act of 2003 (PREA) and its regulation at 28 C.F.R. Part 115 Subpart D, Standards for Juvenile Facilities.

At a minimum, the Contractor will provide a copy of DHS's Zero Tolerance for Sexual Abuse and Harassment pamphlet to all staff members, including staff of subcontractors who have any contact with juvenile at the facility and will provide to the Department confirmation of each staff member's receipt and understanding of the pamphlet to any new staff that may be hired for the duration of the contract. Contractor staff members/subcontractors will not be permitted to provide services until completed sign-off forms are received for those individuals who may come in contact with juveniles at the facility.

The Department may require Contractor's staff, including that of subcontractors to undergo additional Department provided training on their responsibilities under the Department's sexual abuse and sexual harassment prevention, detection and response policies and procedure. The Department will determine whether additional training is required based upon the nature of contracted services and the level of contact with juveniles at the facility.

1.7 ALCOHOL AND CONTROLLED SUBSTANCES

A. Alcoholic beverages and controlled substances shall not be carried, stored or consumed on facility property nor left in any vehicle.

1.8 GAMBLING

A. Gambling or wagering of any type is not permitted on facility property.

1.9 WEAPONS OR IMPLEMENTS FOR ESCAPE

A. Weapons or implements of escape (other than tools applicable in Paragraph 1.4) shall not be permitted on facility property. Non-compliance with this policy may result in criminal charges.

B. Offense Defined - A person commits a 2nd degree felony if that person unlawfully introduces within a Youth Development Center, Mental Health Hospital, or State Center unlawfully provides a resident thereof with any weapon, tool, implement or other item which may be used for escape.

C. Definitions:

1. As used in this section, the word "unlawfully" means surreptitiously or contrary to law, regulation, or order of the detaining authority.

2. As used in this section, the word "weapon" means any implement readily capable of lethal use and shall include any firearm, knife, dagger, razor, other cutting or stabbing implement or club, including any item which has been modified or adapted so that it can be used as a firearm, knife, dagger, razor, other cutting or stabbing implement or club. The word "firearm" includes any unloaded firearm and the unassembled components of a firearm.

1.10 CONTRABAND

A. Contraband shall not be permitted on facility property. Non-compliance with this policy may result in criminal charges. This may include, but is not limited to, cell phones and cameras. Contractor will check for an updated contraband list with local management prior to the beginning of the project.

B. Contraband transferred by any means to confined persons is prohibited. A person commits a misdemeanor of the first degree if that person sells, gives or furnishes to any resident in a Youth Development Center, Mental Health Hospital, or State Center, or gives away or brings into any Youth Development Center, Mental Health Hospital, or State Center or any building appurtenant thereto, or on the land granted to or owned or leased by the Commonwealth for the use and benefit of the residents, or puts in a place where it may be secured by a resident or employee thereof, any kind of spirituous or fermented liquor, drug, medicine, poison, opium, morphine, or other kind of narcotics (except the ordinary hospital supply) without a written permit signed by a physician of such facility, specifying the quantity and quality of the liquor or narcotic which may be furnished to any resident or employee; the name of the resident or employee for whom it is prescribed; and the time when the same may be furnished, which permit shall be delivered to and kept by the superintendent of the facility.

C. Money transferred directly to residents is prohibited. A person commits a misdemeanor of the third degree if that person gives or furnishes money to any resident of a Youth Development Center, Mental Health Hospital, or State Center, PROVIDED NOTICE OF THIS PROHIBITION IS ADEQUATELY POSTED AT THE FACILITY.

1.11 SEARCH

A. Any person entering this facility is subject to a search of his or her person at any time. While the person may refuse, such refusal may be cause for denial of further entrance.

1.12 ORIENTATION PROGRAM

A. The contractor must attend an orientation program covering security rules and regulations if required by the facility and follow all facility safety and security protocols.

B. If not required by the facility, the facility agrees to provide such an orientation program for covering security rules and regulations for the Contractors' personnel, if so requested.

1.13 EMPLOYEE CRIMINAL RECORD CHECK

A. The Prime Contractor must obtain a criminal record check for all of its employees as well as the employees of Subcontractors or suppliers who will be required to enter the building as part of this project. If the Contractor is not a PA resident, an FBI background check is required.

C. The criminal record check must be requested from the Pennsylvania State Police by completing a ‘REQUEST FOR CRIMINAL RECORD CHECK’ FORM and submitting it to the Pennsylvania State Police.

D. All Prime Contractors are responsible for the costs incurred with the record check including the processing fee for all of their employees as well as the employees of Subcontractors or suppliers who will be required to enter the building as part of this project.

E. The forms must be obtained directly from the Pennsylvania State Police.

F. If the Criminal Record Check discloses a criminal record for a Contractor, Subcontractor or supplier employee, the Contractor shall not allow the employee access to the building, unless authorized by the Department.

G. Contractors must submit the request for criminal record check to the Pennsylvania State Police with a copy to the Department not less than twenty-four (24) hours prior to individual starting work on the project.

H. The Contractor shall provide each individual with a photo identification card or badge issued by the Contractor or Subcontractors. The identification card shall include the individual's name, address, telephone number, date of birth, driver's license number and date of issuance of the card.

1.14 FACILITY HEALTH PROTOCOLS

A. All Contractors and their vendors/suppliers/third parties shall maintain compliance with all local facility protocols to prevent the spread of contagious or infectious diseases. Any current protocols can be obtained from the Facility Safety Manager and the Contractor shall request, regular updates following the Initial Job Conference.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 01 6150

DIVISION 02

EXISTING CONDITIONS

SECTION 02 8000 – ASBESTOS ABATEMENT

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

B. References herein to “Contractor”, “Asbestos Abatement Contractor” or “AAC” refer to the properly certified personnel employed directly under the General (.1) Construction Contract.

C. The procedures specified in this section are for minimum performance. Variations to the stipulated work procedures will only be accepted through written approval by Professional Service Industries, Inc. (PSI). The General Contractor (.1) is responsible for conformance to regulatory codes, rules and guidelines. The General Contractor (.1) is required to obtain all permits, licenses and approvals to perform the work, including any rights to use patented systems.

1.2 SCOPE OF WORK

A. A survey for asbestos-containing materials (ACM) was conducted on June 4, 2024, at Danville State Hospital Steam Generation Building, Mahoning Township, Pennsylvania, by PSI and a survey report prepared by accredited individuals. The survey report was used to identify the types and general locations of ACMs within in the building.

B. The work includes removal and disposal of exterior windows containing white glazing and lead based paint.

C. The scope of work for this project covers the filing of required notifications, landfill charges, supplying of all labor, tools, materials, equipment, services and appurtenances to accomplish the work below. The work shall be performed to the complete satisfaction of Client Agency, Architect, and the Environmental Consultant in accordance with the current Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA) regulations, the Pennsylvania Department of Labor and Industry (PA DL&I), the Department of Environmental Protection (DEP), and any other applicable Federal, State and Local Government regulations. The General Contractor (.1) should perform the abatement in accordance with the most stringent of the regulations provided.

D. There must be at least three (3) state licensed workers/supervisors present and working at all times during the scheduled shifts. The General Contractor (.1) must have written approval from the Environmental Consultant and the Client Agency to use less than five certified workers for a specific reason. In addition, sufficient manpower must be provided to maintain the overall project schedule.

E. Submit required documentation in accordance with Client Agency’s “Submittal Procedures”. Copy all communication to Professional and Environmental Consultant.

1. SDS Submittals will not be acted upon by Client Agency, but may be accepted as Information Submittals.

The determination of the exact amount of asbestos-containing materials present is solely the responsibility of the General Contractor (.1).

Work under this project includes, but is not limited to, the following Proper Removal and Disposal of the following asbestos-containing materials:

Material Description	Material Locations	Estimated Quantity
Pipe Insulation – 8” Pipe	Basement tunnel beneath work area	125 LF
White Glazing	Three Exterior Windows	358 LF
Lead-Based Paint		1300 Sq. Ft.

F. General Contractor (.1) is responsible for all demolition required to access ACMs.

G. All loose furnishings and fixtures in the work areas will be removed by the facility maintenance prior to abatement activities. Coordinate with the GC if there are remaining or additional items that need removed from the work areas.

H. The General Contractor (.1) is responsible for a weatherproof seal over the widow opening after the window frames are removed.

1.3 CONTROL OF WORK

A. Work which does not conform to the requirements of the contract, plans and specifications will be considered unacceptable.

B. Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be corrected immediately to an acceptable condition.

C. If the Client Agency or Environmental Consultant finds the materials furnished, work performed, or the finished product not within conformity with the contract documents and have resulted in an unacceptable finished product, the affected work or material shall be corrected by and at the expense of the Contractor.

1.4 QUALITY ASSURANCE

A. Independent testing agency:

1. General Contractor (.1) to coordinate with Environmental Consultant whose purpose will be to establish ambient levels of airborne fibers before, during, and after abatement activities, and to detect faults in the work area isolation that might result in the contamination of the building with airborne asbestos fibers caused by the failure of the air exhausting system or rupture in the containment barriers. The Environmental Consultant will ensure that all work is performed in compliance with OSHA, and EPA, standards and regulations.
2. Airborne fibers referred to above include all fibers regardless of composition as counted by phase contrast microscopy (PCM) in accordance with NIOSH 7400 Procedure. Should the PCM air monitoring detect either a fault in the work area isolation or visible emission, the General Contractor (.1) shall immediately cease asbestos abatement activities until the fault is corrected. Work shall not recommence until authorized by the Environmental Consultant.
3. Any result greater than 0.01 fibers per cubic centimeter (f/cc) collected by an air sample outside the work area shall be considered as evidence of a fault in the work area isolation. The General Contractor (.1) shall strive to maintain the asbestos concentration inside the

work area equal to or less than 0.2 f/cc by engineering and work practice controls. It is recognized that there may be situations when this is not feasible. At the discretion of the Environmental Consultant, levels may exceed 0.2 f/cc, but not 0.5 f/cc. Additional engineering and work practice controls shall be implemented by the General Contractor (.1) should any result from an air sample collected inside the work area exceed 0.5 f/cc.

4. Excessive Airborne Fiber Counts: The following procedures shall be used to resolve any dispute regarding fiber type when a project has been stopped due to excessive airborne fiber counts. Samples will be taken and analyzed by transmission electron microscopy (TEM) utilizing NIOSH 7402 Method by a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory.
5. Personnel Air Samples: The General Contractor (.1) is responsible for monitoring its personnel in accordance with OSHA regulations 29CFR 1926.1101 and mandatory appendices.
6. Asbestos abatement work shall be considered to be substantially complete upon confirmation of visual and final air clearance by the Environmental Consultant.

B. Contractor Experience:

1. The General Contractor (.1) shall have a minimum of two (2) years of experience in the asbestos abatement business and shall have successfully completed three (3) projects of similar or larger size and dollar value to this project and shall not have defaulted on an asbestos abatement project within the last two (2) years. The GENERAL CONTRACTOR (.1) shall furnish documentation of these projects, including names and addresses of the purchaser of the service and the location of the work performed.
2. The General Contractor (.1) shall be certified by the Pennsylvania Department of Labor and Industry. The General Contractor (.1) certification number must be provided to the Client Agency in its bid.
3. The General Contractor (.1) shall provide a list of any outstanding violations received from OSHA, the EPA or any applicable State and Local Governing body that occurred within the last (24) months.

C. Worker Certification:

1. The General Contractor (.1) shall furnish proof that its employees have had instruction on the dangers of asbestos exposure, on respirator use, decontamination, and current OSHA and EPA regulations. Proof of training is to be provided to the Environmental Consultant prior to commencement of abatement activities.
2. Documentation of workers medical exams, consisting of x-rays and pulmonary function shall be submitted to the Environmental Consultant prior to any work being performed and as may be required by current OSHA and EPA regulations and any applicable State and Local Government regulations.
3. There must be on site at all times during abatement activities, an EPA Certified Asbestos Abatement Supervisor. The Asbestos Abatement Supervisor shall have successfully completed an EPA Certified Practices and Procedures Course as per 40 CFR, Part 763, Subpart E, Appendix C-EPA Model Accreditation Part (must provide a copy of certificate from EPA approved course). All asbestos workers shall have successfully completed an EPA Certified Practices and Procedures Course as per 40 CFR, Part 763, Subpart E, Appendix C-EPA “Model Accreditation Plan”. The Contractor must provide copies of current certificates from Pennsylvania Department of Labor and Industry for all workers and supervisors.
4. The Abatement Supervisor and Abatement Workers shall be licensed by the PA DL&I. Each worker/supervisor shall have photo identification issued by PA DL&I available at the work site.

1.5 POSTING OF REGULATIONS

A. The General Contractor (.1) will have at all times in his possession at its office one (1) copy and on view at the job site one (1) copy, current OSHA Regulations 29CFR1926.1101, Asbestos, and current Environmental Protection Agency 40 CFR Part 61, Subpart N: National Emission Standard for Asbestos, Asbestos Stripping Work Practices and Disposal of Asbestos Waste.

1.6 CODES AND REGULATIONS AND REGULATORY AGENCIES SUBMITTALS (GENERAL CONTRACTOR'S (.1) RESPONSIBILITY)

A. Except to the extent that more explicit or more stringent requirements are written directly into the contract documents, all applicable codes, regulations, and standards have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith.

B. The following codes and regulations govern asbestos abatement work, asbestos waste material, hauling and disposal, employee health and safety, and environmental protection:

1. U.S. Department of labor, OSHA, including but not limited to:

    a. Occupation Exposure to Asbestos, Title 29, Part 1910, Section 1001 and Part 1926, Section 1101 of the Code of Federal Regulations.
    b. Respiratory Protection, Title 29, Part 1910, Section 134 of the Code of Federal Regulations.
    c. Training and Work Practices, Title 29, Part 1926, Section 26 of the Code of Federal Regulations.
    d. Employee Exposure and Medical Records, Title 29, Part 1910, Section 20 of the Code of Federal Regulations.
    e. Specifications for Accident Prevention Signage and Label, Title 29, Part 1910, Section 145 of the Code of Federal Regulations.

2. U.S. Environmental Protection:

    a. Regulations for Controlling Visible Emissions, National Emission Standard for Asbestos, Title 40, Part 61, Subpart M of the Code of Federal Regulations.
    b. Guidelines for Disposal of Solid Waste, Title 40, Part 241 of the Code of Federal Regulations.
    c. Criteria for Classification of Solid Waste Disposal Facilities and Practices, Title 40, Part 257 of the Code of Federal Regulations.

3. U.S. Department of Transportation

    a. Hazardous Material Regulations, Title 49, Part 107 of the Code of Federal Regulations.

4. Commonwealth of Pennsylvania, Bureau of Occupational and Industrial Safety

    a. Pennsylvania Act 194, Asbestos Occupations Accreditation and Certification Act.

5. Pennsylvania Department of Environmental Protection

    a. Asbestos Regulations, Title 25, Part 1, Subpart C

C. Notify the following agencies in writing ten (10) days prior to starting work for notification and instructions concerning proper disposal of asbestos waste material. Copies of all notifications shall be sent to the Client Agency and the Environmental Consultant.

1. United States Environmental Protection Agency - Region III
   Asbestos - NESHAP Coordinator (3AT33)
   841 Chestnut Building
   Philadelphia, Pennsylvania 19107

2. Pennsylvania Department of Environmental Protection
   Bureau of Air Quality Control
   P.O. Box 8468
   Harrisburg, Pennsylvania 17105-8468

1.7 AIR TESTING AND MONITORING

A. Air sampling of work areas and surrounding environment will be conducted during the performance of this contract by the Environmental Consultant so as to ensure compliance with all codes, regulations, ordinances and these specifications.

B. General Contractor (.1) shall fully cooperate with the Environmental Consultant and all others responsible for testing and inspecting the work. An air testing and monitoring schedule shall be submitted prior to the start of work.

C. Air testing and analysis shall be in accordance with current EPA and requirements of Section 29CFR 1926.1101 of the current OSHA Regulations, as a minimum. Analysis shall be performed by Phase Contrast Microscopy (PCM) per NIOSH 7400 Method analytical procedures and/or Transmission Electron Microscopy (TEM) per EPA Level II analytical procedures.

D. Air tests taken prior to start of work (background), during abatement activities (areas and personals) and upon completion of removal activities (finals) will be analyzed by PCM.

E. After a work area has passed the Environmental Consultant's visual inspection, final clearance testing will be performed no sooner than 24 hours later.

F. The Environmental Consultant shall give verbal notification to the Client Agency of the final clearance results of each test within 24 hours of the time the samples were analyzed. The Environmental Consultant shall confirm the results in writing within three (3) days thereafter.

G. Prompt reports are necessary so that, if required, modifications to work methods and/or practices may be implemented as soon as possible, if such action is required.

H. Representatives of the Environmental Consultant shall have access to the work area at all times. Provide facilities for such access in order that the Environmental Consultant may properly perform its function.

I. Specimens and samples for testing shall be taken by the testing personnel. Sampling equipment and personnel will be provided by the Environmental Consultant. Air sampling shall be performed in each work area prior to commencement of the work at the location. The highest fiber count reading during pre-clearance clean-up monitoring shall be lower than the background readings established by pre-job monitoring or 0.01 f/cc, whichever is lower.

J. Air sampling shall be taken on, but not necessarily limited to, the following schedule:

Area	When	Number of Samples (minimum)	Volume Sample (liters)	Minimum Collection Rate (liters/min)
Work Area (PCM)	Prior to job start	5	1500	2-10
Work Area (PCM)	During area Isolation	Daily[1]	1000	2-10
Work Area (PCM)	During abatement work	Daily[1]	1000	2-10
Work Area (PCM)[2]	During abatement work	Daily[2]	1000	2-10
Area	When	Number of Samples (minimum)	Volume Sample (liters)	Minimum Collection Rate (liters/min)
Work Area (PCM)	At completion (final)	3	1500	2-10

NOTES:

1 Consecutive daily air samples will be taken during abatement to yield a minimum of eight (8) hours of sampling time for each active work area.
2 Exterior samples shall be taken at all decontamination unit entrance, waste load out exit, and discharge of HEPA exhaust units.

K. Work area clearance testing shall be completed before work site protective barriers are removed.

L. General Contractor (.1) is responsible for performing the thirty (30) minute excursion air sampling per OSHA Regulations.

M. General Contractor (.1) is responsible for performing personal air samples in the employees breathing zone per OSHA regulations.

1.8 AIR FILTERING (FOR GUIDELINE PURPOSES ONLY)

A. An approved pressure/air movement atmosphere may be created in the active work area using HEPA equipped air movement units.

B. Air may be drawn from clean areas through the decontamination and active work areas, HEPA filtered and exhausted through air movement units to the containment exterior. Replace filters in accordance with manufacturer's instructions.

C. Air movement should be sufficient quantity to ensure a minimum of four (4) air changes per hour.

example: Active work area = 50' x 50' x 20' = 50,000 cu. ft.

For four air changes per hour = 4 AC/HR x 50,000 CF/AC = 2000,000 cu. ft./hr.

In cubic feet per minute = 200,000 CF/HR: 60 min./hr. = 3,333 cu. ft./minute

D. The exhaust system must be sufficient to maintain a minimum pressure differential of -0.02 inches of water relative to unsealed, adjacent area. Provide continuous, 24-hours per day monitoring of the pressure differential with an automatic recording instrument.

E. The exhaust system(s) will run twenty-four (24) hours/day until final clearance is obtained and will be maintained in accordance with ANSI Z9.2 and the manufacturer’s directions.

F. To ensure continuous operation, provide a spare negative exhaust unit available.

1.9 ALTERNATIVE AIR FILTERING METHODS

A. Other approved air filtering methods may be utilized with the stipulation that designed regulatory agencies provide documented approval to the Client Agency and the Environmental Consultant. It shall be the responsibility of the General Contractor (.1) to submit all documentation required to the appropriate regulatory agency for their review and approval.

1.10 PLACEMENT OF WARNING SIGNS AND LABELS

A. Warning Signs and Labels: The General Contractor (.1) shall provide warning signs at all approaches to asbestos control areas containing concentrations of airborne asbestos fibers. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scrap waste, debris and other products contaminated with asbestos.
Warning Signs: Provide warning signs conforming to 29 CFR 1926.1101 with the following legend:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE
REQUIRED IN THIS AREA

Provide spacing between lines at least equal to the height of the upper of any two lines.

B. Caution Labels: Attach label to each disposal bag and container, displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
DO NOT BREATHE DUST

C. Identification Label: Attach label to inner opaque or colored disposal bag so that it remains visible through the clear outer bag. Attach labels to container transported from facility site. Text shall include the following legend:

Waste Generator Name: _____

Generator Location: _____

D. Transportation Marking: In accordance with 49 CFR 107, provide marking on all containers with more than one pound of friable asbestos, as follows:

NA2212
RQ ASBESTOS
PGIII
CLASS 9

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. The list of required materials will include, but is not necessarily limited to the following:

1. Respirators: Provide respiratory protection in accordance with OSHA Regulation 29 CFR 1926.1101 and ANSI Z88.2-1980. Respiratory protection shall be as listed below. There shall be NO EXCEPTION to this requirement. No employee or visitor shall enter the area without this protection until all visible asbestos has been removed from this area. Employees or visitors shall wear this type respirator. Respirators shall be NIOSH/MSHA approved.
2. Protective Clothing: Provide only disposable protective clothing with material composition of layered polypropylene or spunbonded polyethylene nonwoven material. Disposable protective clothing is to be worn once and disposed of as asbestos-contaminated waste upon exiting from the work area. Suits shall have zipper front and attached hood and shoe covers. “Tyvek" by DuPont, or approved equal are acceptable disposable coveralls. Gloves will be worn for hand cover as required.
3. Wetting Agents: The asbestos material will be sprayed with water containing an additive to enhance penetration. The additive, or wetting agent, will be polyoxyethylene at a concentration of one (1) ounce per five (5) gallons of water, or equal. A fine spray of this solution must be applied to prevent fiber disturbance preceding the removal of the asbestos material. The asbestos will be sufficiently saturated to prevent emission of airborne fibers in excess of the exposure limits prescribed in the current OSHA standards referenced in these specifications. Dry removal will not be allowed except with written approval.
4. Polyethylene sheeting: Actual thickness must be six (6) mils, for vertical protection (walls, doors, windows) and for all other uses (floors, fixed equipment, HVAC supply and return openings). Industry Standard “6 mil” sheet is not acceptable.
5. Polyethylene bags (with warning labels) six mil (.006") minimum for disposal. All asbestos that is removed shall be double bagged.
6. Tape: High quality vinyl or fabric duct tape. Paper masking tape will not be permitted.
7. Negative Pressure Filtration Equipment: Air movement and filtering equipment equipped with HEPA filters rated at 99.97% removal down to 0.3 microns, and of sufficient capacity to provide a minimum of four (4) air changes per hour for each active work area.
8. Airless Spray Equipment: Electric airless spray equipment for saturating and mist fiber control. Low-pressure (500 psi) equipment must be available on-site and utilized as required.
9. Vacuum: HEPA rated for surface cleaning and housekeeping. Hand operated and power tools such as, but not limited to, saws, scorers, abrasive wheels and drills should be provided with local exhaust ventilation systems with HEPA filters.
10. Hand tools: Brooms, plastic shovels, scrapers, brushes, etc., in sufficient quantity to ensure the appropriate level of housekeeping.
11. Water Filtration System: Shower and contaminated water filtration system.
12. GFI Equipment: All electrical connectors in the work area must be through "ground fault" protected outlets/circuits.
13. Penetrating Encapsulant: Penetrating encapsulants to be used on this project are International Cellulose Corporation SK-13 Asbestos Encapsulant, International Protective Coatings Corporation Serpiflex Shield, Fiberlock Technology ABC Asbestos Binding Compound Concentrate, and others listed as acceptable in the Environmental Protection Agency - Battelle Laboratory Encapsulant Study, or approved equal.
14. SDS for all materials shall be submitted to Independent testing agency and kept on site.

2.2 PERSONNEL PROTECTION

A. Personnel protection is required for laborers, mechanics, supervision and visitors at the work site during the set-up and abatement operations.

B. Each worker shall be supplied with a minimum of two (2) complete protective work clothes and respirator filter changes per day for the complete duration of the project. Hard hats should be

available as appropriate which meet ANSI Z-89.1 standards. Safety toe footwear is to be worn underneath the disposable or recyclable shoe coven and must meet the requirements and specifications in ANSI Z-41-1. Eye wear and face protection must meet the standards and specifications of ANSI Z-87.1.

C. In addition to sets of protective work clothes for workers, the Contractor shall have on hand two (2) additional sets of disposable work clothes per day for personnel who are authorized to inspect the work site. Hard hats should be available as appropriate which meet ANSI Z-89.1 standards. Safety toe footwear is to be worn underneath the disposable or recyclable shoe covers and must meet the requirements and specifications in ANSI Z-4 I-1. Eye wear and face protection must meet the standards and specifications of ANSA Z-87.1.

D. Respirators approved for asbestos use and protective work clothes will be worn by laborers and mechanics as a minimum during set-up operations (plastic draping, light-fixture dropping or removal, etc.).

E. Appropriate respirators will be worn by all personnel in the active work area.

F. Upon leaving the active work area, filters will be discarded, cartridges removed, and respirators cleaned in disinfectant solution and clean water rinse.

G. Clean respirators will be stored in plastic bags when not in use.

H. Respirators will be inspected daily for broken, missing, or deteriorated parts.

PART 3-EXECUTION

3.1 AREA PREPARATION

A. Moveable items and equipment will be removed from the area by the Client Agency.

B. Prior to starting the abatement, provide to the Client Agency and the Environmental Consultant the intended methods for set-up and abatement. Issues to be covered must include type of containment, location of decontamination chambers, method to remove ACMs, safety data sheets (SDS) of any solvents to be used, landfill to be used for disposal of asbestos-containing materials, and a schedule for project completion.

C. Temporary Electrical Services within Containment Area: As required, coordinate with the Client Agency's access and connection to temporary power and arrangements for temporary lighting. Ensure safe use of temporary power sources and equipment in compliance with the requirements of the UL Code. Provide ground fault circuit interrupters (GFCI) for all equipment and utility circuits. All extension cords shall be grounded. See Section 01 5000 and Division 26.

D. Plumbing and Sanitary Services within Containment Area: Provide for temporary water from existing building sources to control the generation of airborne dust, to allow for area, personnel, and equipment decontamination, and to supply decontamination unit needs. Also, provide for temporary sanitary drainage piping to decontamination unit sump at a minimum slope of 2.0%, and temporary drainage piping to waste water pump and existing drain in accordance with local standards.

E. Isolate the work area for the duration of the work by installing critical barriers completely sealing off all openings in the work area, including, but not limited to, heating ventilation ducts, doorways, corridors, windows, roof ventilator openings, and wall vents, with plastic sheeting taped securely in place.

F. Under no circumstances will the General Contractor (.1) allow any containment areas to be broken.

G. Provide decontamination chamber(s) to be connected to each active work area for entrance to or exit from the active work area. When required a separate material load-out unit shall be provided.

3.2 DECONTAMINATION CHAMBER (USAGE AND ACTIVITIES)

A. Outside room (clean room). In this room the worker leaves all street clothes and dresses in clean working clothes. Respiratory protection equipment is also picked up in this area. No asbestos contaminated items should enter this room. Workers enter this room either from outside the structure dressed in street clothes, or naked from the showers, after showering.

B. Shower Room: This is a separate room used for transit by cleanly dressed workers entering the job from the outside room or by workers headed for the showers after undressing in the equipment room.

C. Equipment Room (contaminated area): Work equipment, footwear and additional contaminated work clothing are left here. This is a change and transit area for workers.

D. Decontamination facilities require temporary utility services. Verify during bidding period the availability for temporary hook up. Mobilization, hook-up and demobilization, disconnection costs will be the responsibility of the Contractor. Installation of temporary services during demolition shall be per current EPA and OSHA regulations.

E. Work Area: The work area should be separated by polyethylene barriers from the equipment room. If the airborne asbestos level in the work area is expected to be high, as in dry removal an additional intermediate cleaning space may be added between the equipment room and the work area. Isolation of the work areas, as required, is necessary to prevent contamination and fiber dispersal to other areas of the building during work and clean-up operation. Air movement will flow uninterrupted from outside the work area through the change and equipment moms into the active work area. It is then HEPA filtered and exhausted to the building exterior.

3.3 WORK AREA ENTRANCE/EXIT

A. All workers involved in the removal of asbestos will utilize the following procedure for work area entrance and exit.

B. The worker enters outside room and removes clothing, puts on clean uniform, gloves and respirator. Gloves will be taped to uniform sleeves and boots taped to coverall legs. Uniforms will be taped closed at neck, zipper seams, wrists and ankles.

C. Any additional clothing and equipment left in dirty room required by the worker is put on. (When the work area is too cold for coveralls only, worker will usually provide himself with additional warm garments. These must be treated as contaminated clothing and left in the decontamination area.)

D. Worker proceeds to work area.

E. Before leaving the work area, the worker shall remove all gross contamination and debris from the coveralls, by vacuuming down the clothes with a vacuum cleaner with a HEPA filter. In practice, this is carried out by one worker assisting another.

F. The worker proceeds to equipment room and removes all clothing except respiratory protection equipment. Extra work clothing may be stored in contaminated end of the area.

G. Disposable coveralls are placed in a bag for disposal with other material. The worker then proceeds into the shower room. Respiratory protection equipment should only be removed after wetting in shower to prevent inhalation of fibers. Ensure that employees shower daily before entering the clean room.

H. After showering, the worker moves to the clean room and dresses in either new coveralls for another entry or street clothes if leaving.

I. Respirators are picked up, washed and wrapped by protected workers. The respirators are then brought to the clean room by an outside worker.

J. Workers shall not eat, drink, smoke, chew gum, or chew tobacco in the work area. To eat, drink or smoke, workers shall follow the decontamination procedure outlined above.

K. All footwear shall be left inside work area until completion of the job, then cleaned or discarded.

3.4 METHOD OF REMOVAL

A. Remove and dispose of all asbestos-containing materials in accordance with the more stringent methods and procedures as outlined in the United States Department of Labor, OSHA Asbestos Regulations, Codes of Federal Regulations Title 29, Part 1926, Section 1926.1101 or as are written directly into the contract documents.

B. Dry removal will not be allowed except when wet removal will create a safety hazard. Dry removal process will require written authorization by the USEPA.

C. Work of this section shall be performed in the following manner:

1. Eliminate airflow into containment area by isolating all supply and return air ducts from mechanical system. Turn off electrical power.
2. Install six (6) mil polyethylene critical barriers over all windows, doors, wall openings, ceiling openings, electrical outlets, ventilation points of entry/exit, etc. Secure with duct tape on all sides.
3. Six (6) mil polyethylene protecting ceiling surface from wall to wall, where needed.
4. Isolation barriers separating occupied areas and work areas shall be framed and covered with ½ inch plywood and two (2) layers of six (6) mil polyethylene.
5. Duct HEPA filter unit through window. Locate unit to prevent dead air pockets.
6. Install triple air curtain, six (6) mil polyethylene (typical), over door opening into decontamination unit or load out unit
7. Utilize wet methods with amended water
8. ACM waste must be removed and disposed of by the end of each work shift.

D. Vacuum any remaining material from sub surfaces, i.e., wire lath, concrete, pipe and steel joists.

E. All polyethylene, tape, clothing and cleaning materials shall be bagged and disposed of as specified.

F. Clean all equipment, tools, etc., prior to removing them from work area.

G. Remove polyethylene on walls and ceiling. Critical barriers sealing all windows, doors, wall openings, ceiling openings, electrical outlets, etc., are to remain. Treat polyethylene as asbestos-contaminated materials.

H. Place asbestos-containing and asbestos-contaminated material while still wet into sealable, opaque or colored six (6) mil polyethylene bags. Do not overfill, place more than twenty-five (25) pounds into it or use it for disposal of sharp-edged materials.

I. Evacuate the bag with HEPA vacuum and seal collapsed bag by twisting top six (6) inches closed and wrapping with a minimum of two (2) layers of duct tape.

J. Twist top and fold over, apply second wrap of duct tape.

K. Clean outside of disposal bag by wet wiping and take bag to the equipment and staging area.

L. Affix warning and identification labels to opaque or colored bag and then place bag inside a second, six (6) mil polyethylene bag.

M. Seal outer bag by repeating steps I. and J.

N. Double-bagged waste shall be placed into a lined, covered receptacle or dumpster. Wastes must not remain on the ground.

O. HEPA filter unit to remain in place until space has been cleared by clearance test results.

P. Door into decontamination unit or load out room to remain.

Q. The Environmental Consultant will perform a visual inspection to verify all ACM has been removed.

R. The Environmental Consultant will perform final air clearance testing.

S. Remove critical barriers upon instructions from the Environmental Consultant.

T. Any alternate method of removal must have the written approval of the Client Agency and the Environmental Consultant.

3.5 HOUSEKEEPING

A. Throughout the work period, maintain the building and site in a standard of cleanliness as specified throughout these specifications.

B. Contaminated disposable clothing, respirator filters and other debris will be bagged, properly labeled and sealed at the end of each workday.

C. All asbestos generated by removal, encapsulation or repair will be bagged, properly labeled, and sealed at the end of each workday.

D. Respirators will be thoroughly cleaned at the end of each workday and stored for the next day's use.

E. Retain all stored items in an orderly arrangement allowing maximum access, not impeding traffic, and providing the required protection of materials.

F. Do not allow the accumulation of scrap, debris, waste material, and other items not required for completion of this work.

G. At least weekly, and more often is necessary, completely remove all scrap, debris and waste material from the job site.

H. Unless otherwise noted or directed, materials resulting from demolition operations shall be the property of the General Contractor (.1), shall not be used in the work and shall be promptly removed from the site.

I. Daily and more often if necessary, inspect the work areas and adjoining spaces, and pick up all scrap, debris and waste material. Remove all such items to the place designated for their storage.

J. Provide adequate storage for all items awaiting removal from the job site, observing all requirements for fire protection and protection of the ecology.

K. Maintain the site in a neat and orderly condition at all times.

L. Compressed air is not to be used for cleaning purposes.

3.6 FINAL DECONTAMINATION OF WORK AREA

A. Carefully double bag all removed asbestos material, labeling bags as required.

B. Bags shall be wiped with clean damp cloths prior to transportation to approved disposal site.

C. Plastic barriers, as specified, shall be carefully removed, folded inward rolled into bundles and bagged for disposal. Note: Final barriers are not to be removed until work is completed and instructed by the Environmental Consultant.

D. During decontamination of the work area (after asbestos removal), the General Contractor (.1) shall remove the polyethylene sheets from walls and floors only. The windows and doors shall remain sealed and any HEPA filtration systems shall remain in service until final acceptance.

E. Hard surfaces flooring such as concrete, terrazzo, VAT and ceramic tile, shall be wet mopped, allowed to dry, and damp mopped a second time with clean mop heads.

F. Walls, furniture and equipment (which remain in work area during work operations), windows and other surfaces shall be thoroughly cleaned with damp cloths.

G. And carpeting shall be cleaned with a HEPA type vacuum cleaner.
CONVENTIONAL VACUUMS WILL NOT BE PERMITTED.

H. All surfaces are to be left visually clean.

I. After the work area is found to be in compliance by visual inspection, and before removing plastic barriers, the Environmental Consultant shall take clearance samples as specified in Air Sample Schedule, Section 2B-7 as soon as feasible but not sooner than twenty-four (24) hours after completion of all cleaning work, or as may be specified by the Client Agency. If analysis results of all samples are below 0.01 fibers per cubic centimeter (f/cc) or 70 structures per square millimeter (S/mm^2), final air clearance has been achieved and the response action is complete.

J. Should final air clearance fail to meet the standard established above, the General Contractor (.1) shall pay all costs associated with the Environmental Consultant's re-sampling and analysis. At Contractor's sole option and at no additional cost to the Client Agency, PCM samples which fail to meet the clearance levels can be tested for compliance by the TEM protocol established in NIOSH 7402.

K. If pre-clearance criteria are not met, repeat final cleaning until additional tests indicate conformity before proceeding with final clearance.

L. All mop heads and cleaning cloths are to be discarded in the same manner as asbestos waste.

M. Clean all glass inside of work area.

N. All windows, doors, louvers, etc., shall be unsealed and the sheeting, tape etc., shall be disposed of as heretofore prescribed.

O. All plastic sheeting, tape, cleaning materials, clothing and all other disposable material or items used in the work area shall be packed into sealable plastic bags (6-mil. minimum) for transport. Double bagging is required.

3.7 DISPOSAL OF ASBESTOS WASTE

A. All asbestos materials and miscellaneous debris will be transported to the pre-designated disposal site in accordance with the guidelines of the U.S. EPA, Tide 40, Part 61, Subpart H, and all local agencies' regulations.

B. The landfill used for dumping shall be certified to receive and buy materials contaminated by asbestos.

C. Obtain signed waste shipment record indicating material is asbestos waste, and site it came from. Waste Disposal Manifests must also indicate amount of waste in cubic yards or tons.

D. Submit Waste Disposal Manifests to the Client Agency and the Environmental Consultant with final report.

3.8 RECORDKEEPING AND LOG

A. Maintain a daily log documenting the following items:

1. Entry and exiting of work area by work personnel, visitors, and inspectors.
2. Personnel air monitoring test results.
3. Special or unusual events, such as power loss or equipment failure.
4. Daily inspection of decontamination unit, load-out unit, containment area integrity, and air exhausting system.
5. Amount of asbestos-containing material removed from the work site.
6. Work progress narrative.

B. Provide a copy of the log to the Client Agency and the Environmental Consultant at the end of the project.

3.9 INSPECTIONS

A. All work procedures detailed in this specification will be strictly adhered to and meet or exceed all current EPA, OSHA, DEP, ACHD, and PDL&I regulations.

B. All work shall meet with the approval of the Client Agency and the Environmental Consultant. Work which does not meet with such approval shall be determined to be unsatisfactory.

END OF SECTION 02 8000

SECTION 02 8200 - HAZARDOUS MATERIALS ABATEMENT

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

B. References herein to “Contractor”, “Hazardous Materials Abatement Contractor” or “HMAC” refer to the properly certified personnel employed directly under the General Construction Contract.

C. The procedures specified in this section are guidelines for minimum performance. The Contractor is responsible for his own methods of operations and conformance to regulatory codes, rules and guidelines. The Contractor is required to obtain all permits, licenses and approvals to perform the work, including any rights to use patented systems.

1.2 SCOPE OF WORK

A. A survey for asbestos-containing materials (ACM) was conducted on June 4, 2024, at Danville State Hospital Steam Generation Building, Mahoning Township, Pennsylvania, by PSI and a survey report prepared by experienced individuals. The survey report was used to provide the estimated quantities of each identified hazardous material in the scope of work.

B. The work includes removal and disposal of asbestos pipe insulation, lead-based paint, and window glazing. The Contractor is responsible to furnish all labor, materials, facilities, equipment, services, permits and agreements necessary to perform the work required for removal of these materials in accordance with these specifications, and all local, state and federal regulations.

C. The scope of work for this project covers the filing of required notifications, landfill charges, supplying of all labor, tools, materials, equipment, services and appurtenances to accomplish the work below. The work shall be performed to the complete satisfaction of the Client Agency and the Environmental Consultant, in accordance with the current EPA and OSHA regulations, and any other applicable State and Local Government regulations.

D. The determination of the exact amount of hazardous materials present is solely the responsibility of the Contractor. The Contractor should verify all measurements of the amounts of items to be removed.

E. The painted materials in the building contain lead. In accordance with 29 CFR 1926.62, all Contractors are required to notify all employees involved in the construction, alteration and/or repair of lead-containing building components, regardless of the exposures, of the presence of lead, prior to project commencement. The Contractors are also required to conduct an initial Employee Exposure Assessment in accordance with 29 CFR 1926.62 (d) (1) (i). Prior to any torch cutting, sanding, or grinding of painted surfaces, lead paint shall be abated by a certified and licensed Lead Abatement Contractor. In addition, if painted materials are to be disposed off-site, they shall be tested to determine if the lead in the paint is at a level considered to be a hazardous waste. This testing consists of a toxicity characteristic leaching procedure (TCLP) test.

F. Submit required documentation in accordance with Division 01 Section “Submittal Procedures”. Copy all communication to Client Agency and Environmental Consultant.

1. SDS Submittal will not be acted upon by Environmental Consultant, but may be accepted as Information Submittals.

G. Work under this project includes, but is not limited to the proper removal and disposal of the following hazardous materials:

Hazardous Materials	Material Locations	Approx. Quantity
Pipe Insulation – 8" pipe	Basement tunnel beneath work area	20 LF
White Glazing	Three (3) exterior windows	200 LF
Lead Based Paint		1300 Sq. Ft.

H. The hazardous materials abatement work shall be performed in accordance with the schedule provided by the Client Agency, Professional, and Environmental Consultant.

I. The General Contractor (.1) shall perform the work in accordance with these specifications, the contract documents, the drawings, all applicable regulation and all requirements of the Client Agency.

J. Anticipated Work Schedule

1. The specific work schedule will be established by the Client Agency and/or Professional.

PART 2 – ENVIRONMENTAL REQUIREMENTS

2.1 PROTECTIVE CLOTHING

A. Use special clothing, including but not limited to: disposable gloves (polyethylene) and eye protection.

PART 3 – WORK OPERATIONS

3.1 WORK METHODS

A. Ensure that work operations or processes involving mercury are conducted in accordance with 40 CFR 761 and the applicable requirements of this section, including but not limited to:

1. Obtaining advance arrangements of recycling / disposal sites.
2. Notify the General Contractor prior to commencing the operation.
3. Reporting leaks and spills to the General Contractor.
4. Cleaning up spills.
5. Inspecting waste containers for leaks and forwarding copies of inspection reports to the General Contractor.
6. Maintaining inspection, inventory and spill records.

B. Hazardous materials work that is subcontracted must be performed by a licensed hazardous materials abatement company with certified personnel and must comply with all federal, state and local requirements.

C. For lead work, air and wipe samples shall be collected in accordance with, but not necessarily limited to, the following schedule or as directed by the Department:

Air samples will be required daily outside of the work area in occupied buildings only. Wipe samples will be required outside of the work area inside of the building only when visible dust is

encountered. Generally, any time during the course of the work outside of the work area (inside building), airborne lead or wipe concentrations exceed either the background concentrations or, 30 micrograms per meter cubed for air, the area shall be deemed contaminated unless otherwise determined by QA. Input from QA to evaluate sample results for project specific circumstances is required. The Contractor shall be required to halt lead activities and take corrective measures to reduce lead concentrations (misting, wet wiping, and HEPA vacuuming, etc). Work may not commence until the source of the contamination has been identified and the area decontaminated if needed, and additional samples have been collected to verify acceptable levels.

D. For lead work, clearance sampling shall be conducted in work areas in accordance with Department of Housing and Urban Development's "Guidance for the Evaluation and Control of Lead-Based Paint Hazards in Housing," Chapter 15, June 1995. As allowed per HUD regulations, Chapter 14, 4. (p. 14-16) and Chapter 15, IV, C (p.15-11), use sealants on surfaces before wipe sampling clearance is conducted except as otherwise noted in specifications. Clearance wipe sampling is only required for uncontained dust generating activities. Visual inspection is required for all LBP activities. Work areas will be considered appropriate for re-occupancy when the following conditions are met:

Window Sills:	<250 micrograms per square foot
Window Well:	<400 micrograms per square foot
Exterior Concrete or other Rough Surfaces	< 800 micrograms per square foot

Wipe and soil samples shall be analyzed via EPA SW-846 method 7420.
The contractor must achieve these clearance levels in all regulated areas regardless of baseline levels. For areas outside the regulated work area if background wipe samples collected by the QA indicate a baseline level of surface contamination greater than those defined above, the contractor will only be required to clean to the baseline level.

Soil samples shall also be collected by QA, in addition to wipe samples, for exterior work. Clearance criteria is <400 ppm (mg/kg) or lower than baseline

3.2 SPILL/CLEAN-REQUIREMENTS

A. Immediately report to the Environmental Contractor any spills / leaks.

B. Rope off area around edges of leak or spill and post caution signs at the area.

C. Initiate cleanup of spills as soon as possible. Mop up any liquid with rags or other conventional absorbent. The spent absorbent shall be properly contained and disposed of as solid waste.

D. Document the cleanup with records of decontamination in accordance with 40 CFR 761, Section 125, Requirements for Spill Cleanup. Provide certification of decontamination.

PART 4 - STORAGE / LABELING OF CONTAINERS

4.1 MATERIAL STORAGE

A. If materials are temporarily stored on site, all materials must be stored in accordance with all applicable federal, state and local laws. Date the item was placed in storage and the name of the activity and building.

B. Affix caution labels to all hazardous waste containers.

C. The Contractor shall perform itemize counts of all hazardous materials and this information shall be submitted to both the Client Agency and the Environmental Consultant. Signed manifests must be returned to the Client Agency and the Environmental Consultant within 45 days of disposal/recycling.

D. The Contractor shall affix proper labels to all CFC purged equipment. The Contractor shall provide written and signed documentation that all CFCs have been purged and the equipment has been properly labeled. Copies of this documentation and itemized counts shall be submitted to both the Client Agency and the Environmental Consultant. Signed manifests must be returned to the Client Agency and the Environmental Consultant within 45 days of disposal/recycling.

PART 5 - IDENTIFICATION NUMBER

5.1 FEDERAL ID NUMBER

A. Federal regulations require that generators, transporters, commercial storage facilities and disposers of regulated hazardous waste possess U.S. EPA identification numbers. The Contractor shall verify that the activity has a U.S. EPA generator identification number for use on the Uniform Hazardous Waste Manifest (EPA form 8700-22). If not, the Contractor shall advise the activity that it must file and obtain an identification number with EPA prior to commencement of removal work. (Not applicable to item listed in 6.01)

PART 6 - TRANSPORTER CERTIFICATION / CERTIFICATE OF DISPOSAL

6.1 DISPOSAL REQUIREMENTS

A. Comply with disposal requirements and procedures as outlined in 40 CFR.

B. Certificate for the hazardous materials disposed of and/or recycled shall include:

1. The identity of the disposal facility, by name, address and EPA identification number.
2. The identity of the hazardous waste affected by the Certificate of Disposal including reference to the manifest number for shipment.
3. A statement certifying the fact of disposal/recycling of the identified hazardous waste, including the dates of disposal and identifying the disposal process used.

END OF SECTION 02 8200

SECTION 02 4119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PRE-INSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property for dust control and for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of facility's continuing occupancy of portions of existing building and of using agency's partial occupancy of completed Work.

C. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

A. Using Agency will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so operation of the building will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by the using agency as far as practical.

C. Notify Design Professional of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Design Professional. Hazardous materials will be removed under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1. Roof

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at

Project closeout.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with using agency's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction. The Using Agency does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 1.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and for at least 30 minutes after flame-cutting operations
5. Maintain adequate ventilation when using cutting torches.
6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
8. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Protect items from damage during transport and storage.

3. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Design Professional, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Division 1.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.7 SELECTIVE DEMOLITION SCHEDULE

A. Remove: As indicated on drawings.

B. Existing to Remain: As indicated on drawings.

END OF SECTION 02 4119

DIVISION 03

CONCRETE

SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: Provide a design mix complying with ACI requirements for each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Each mix design shall indicate 7 and 28 days concrete compressive strengths, cement content, air content, water-cement ratio, amount of fine and course aggregates, and admixtures.
2. Indicate amounts of mix water to be withheld for later addition at Project site if any.
3. Provide back-up test data complying with ACI requirements for each mix design.
4. Submit documentation that the quantity of Portland cement and blended cement components provided in each meets the blended cement mix criteria specified herein.

C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures. Provide ACI Class B lap splice for all lapped reinforcement bars.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials.

F. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Cementitious materials and aggregates.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.

4. Admixtures.
5. Waterstops.
6. Curing materials.
7. Floor and slab treatments.
8. Bonding agents.
9. Vapor barriers.
10. Epoxy joint filler.
11. Joint-filler strips.
12. Repair materials.

G. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

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

1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

E. ACI Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI CP-1, “Technician Workbook for ACI Certification of Concrete Field Testing Technician – Grade I.”
2. ACI 117, “Specifications for Tolerances for Concrete Construction and Materials.”
3. ACI 211.1, “Standard Practice for Selecting Proportions for Normal, heavyweight, and Mass Concrete.”
4. ACI 301, “Standard Specifications for Structural Concrete.”
5. ACI 304R, “Guide for Measuring, Mixing, Transporting and Placing Concrete.”
6. ACI 305R, “Hot Weather Concreting.”
7. ACI 306R, “Cold Weather Concreting.”
8. ACI 315, “Details and Detailing of Concrete Reinforcement.”
9. ACI 318, “Building Code Requirements for Structural Concrete and Commentary.”

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.8 PRE-INSTALLATION MEETING

A. Contractor shall utilize the Pre-Installation Meeting Agenda and Pre-Installation Meeting Checklist documents in the Z Standard Training and Documentation: Documents\03-Construction-Training and Guidance Documents\03-Role Based Training and Guidance Documents\Contractors.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Meetings."

1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixes.
c. Ready-mix concrete producer.
d. Concrete subcontractor

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

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

1. Plywood, metal, or other approved panel materials. Do not use form-facing materials with defects that will impair the texture of concrete surfaces.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4- by 3/4-inch, minimum.

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

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

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

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

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

B. Plain-Steel Wire: ASTM A 82, as drawn.

C. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

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

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

B. Joint Dowel Bars: Plain-steel bars, ASTM A 615, Grade 60, deformed unless specified otherwise. Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I/II.

1. Fly Ash: ASTM C 618, Class C or F.
2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag cement.

C. Silica Fume: ASTM C 1240, amorphous silica.

D. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:

1. Class: Severe weathering region, but not less than 3S typical except not less than 4S for concrete pavements, bridge decks, driveways and curbs, walks, patios, garage floors, exposed floors and porches, or waterfront structures exposed to frequent wetting or not less than 5S for exposed architectural concrete.
2. Nominal Maximum Aggregate Size: 1 inch.

E. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

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

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.6 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Profile: Flat, dumbbell with center bulb.

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

1. PVC Waterstops:

a. Greenstreak.
b. Progress Unlimited Inc.
c. Westec Barrier Technologies; Div. of Western Textile Products, Inc.

C. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Volclay Waterstop-RX; Colloid Environmental Technologies Co.
b. Conseal CS-231; Concrete Sealants Inc.
c. Swellseal Joint; De Neef Construction Chemicals (U.S.) Inc.
d. Hydrotite; Greenstreak.
e. Mirastop; Mirafi Moisture Protection, Div. of Royal Ten Cate (USA), Inc.
f. Adeka Ultra Seal; Mitsubishi International Corporation.
g. Superstop; Progress Unlimited Inc.

D. Preformed Waterstop: Manufactured single-component, self-sealing adhesive compound, formulated non-swelling square strip joint sealant that provides waterproof bond to both fresh and cured concrete surfaces.

1. Basis-of-Design: The design for preformed waterstop is based on Synko-Flex as manufactured by Henry Company, El Segundo, CA; Telephone: 310-955-9200. Subject to compliance with the requirements provide the named product or a comparable product.

2.7 VAPOR BARRIER

A. Plastic Vapor Barrier: ASTM E 1745, Class A, not less than 15 mils thick; include manufacturer's recommended adhesive or pressure-sensitive tape.

B. Vapor Barrier shall comply with the following qualities:

1. Permeance of less than 0.01 Perms per ASTM F 1249 or ASTM E 96.
2. Maintain permeance of less than 0.01 Perms after mandatory conditioning tests per ASTM E 154 Sections 8, 11, 12, and 13.
3. Non-woven.

C. Products: Subject to compliance with requirements, provide one of the following products:

1. Carlisle; MonarFlex.
2. Reef Industries, Inc.; VaporGuard
3. Stego Industries, LLC; Stego Wrap, 15 mils.

2.8 FLOOR AND SLAB TREATMENTS

A. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Unpigmented Mineral Dry-Shake Floor Hardener

a. Non-Metallic Floor Hardener; Burke Group, LLC (The).
b. Concolor; ChemMasters.
c. Conshake 500; Conspec Marketing & Manufacturing Co., Inc.
d. Quartz Tuff; Dayton Superior Corporation.
e. Surflex; Euclid Chemical Co.
f. Quartzplate; L&M Construction Chemicals, Inc.
g. Maximent; Master Builders, Inc.

2.9 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

C. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.

D. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.10 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8- to 1/4-inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4-inch.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8- to 1/4-inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5700 psi at 28 days when tested according to ASTM C 109/C 109M.

C. Products: Subject to compliance with requirements, provide one of the following:

1. Repair Topping

a. Mastertop 112 Topping; Master Builders.
b. Quikrete Self-Leveling Floor Resurfacer Fast-Set; Quikcrete.
c. Ultratop; Mapei.

2.11 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

C. Footings, Foundation Walls, and Piers: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): 3000 psi.
2. Maximum Slump: 4 inches.
3. Maximum Slump for Concrete with a Type I or II Plasticizing Admixture or Containing High-Range Water-Reducing Admixture: 8 inches after admixture is added to concrete with 2- to 4-inch slump.
4. Maximum Water-Cementitious Materials Ratio: 0.50.

D. Slab-on-Grade: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 4500 psi for exterior sidewalks.
2. Compressive Strength (28 Days): 4000 psi for interior slabs-on-grade.
3. Minimum Cementitious Materials Content: 520 lb/cu. yd.
4. Maximum Slump: 5 inches.
5. Maximum water-cementitious ratios:

a. Compressive Strength (28 Days) 4500 psi: 0.45.
b. Compressive Strength (28 Days) 4000 psi: 0.50.

E. Slab-on-Deck: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 4000.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd.
3. Maximum Slump: 4” or (verified 3” plus or minus 1” before adding water-reducing admixture or plasticizing admixture)
4. Maximum water-cementitious ratios:

a. Compressive Strength (28 Days) 4000 psi: 0.50.

F. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent portland cement minimum, with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

G. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete exposed to deicers or subject to freezing and thawing while moist.

H. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2 to 4 percent, unless otherwise indicated.

I. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:

1. Air Content 6 Percent: For all concrete in contact with soil and/or exposed to deicing chemicals including, but not limited to the following: footings, foundation walls, piers, slabs-on-grade, stairs-on-grade, sidewalks.

J. Do not air entrain concrete for trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.

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

L. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

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

1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.50.

2.12 FABRICATING REINFORCEMENT

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

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

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

PART 3 - EXECUTION

3.1 FORMWORK

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

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

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

1. Class A, 1/8-inch for smooth surface concrete.

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

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

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

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

H. Chamfer exterior corners and edges of permanently exposed concrete.

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

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

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

3.2 EMBEDDED ITEMS

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

1. Install anchor bolts, accurately located, to elevations required.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by the Professional.

3.4 VAPOR BARRIERS

A. Vapor Retarder: Place, protect, and repair vapor-barriers sheets according to ASTM E 1643 and manufacturer's written instructions.

3.5 STEEL REINFORCEMENT

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

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

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

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

E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least 18-inches. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

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

B. Construction Joints: Install per typical details on structural drawings so strength and appearance of concrete are not impaired, at locations indicated or as approved by Professional.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints and, provide minimum ACI Class B lap splice with reinforcement on opposite side of construction joint, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2-inches into concrete.
3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form contraction or weakened-plane contraction joints, sectioning concrete into areas as indicated. Provide contraction joints in slabs-on-grade at each grid line and limit spacing to 12 feet on center each direction, unless noted otherwise on the structural drawings. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. “Soft-cuts” using early entry dry-cuts saws shall be within one to two hours of finishing concrete. Conventional saw cutting must be delayed to leave concrete undamaged, usually 4 to 12 hours, but not so long that uncontrolled cracking occurs.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column piers, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2-inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Dowel Joints: Install per typical details shown on structural drawings and install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.

1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 WATERSTOPS

A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.

3.8 CONCRETE PLACEMENT

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

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

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

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

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

E. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

F. Deposit and consolidate concrete for slab-on-grade in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

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

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

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

H. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

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

3.10 FINISHING FLOORS AND SLABS

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.

1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

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

1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system
2. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:

a. Specified overall values of flatness, F(F) 35; and levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and levelness, F(L) 17; for slabs-on-grade.

E. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

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

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

G. Mineral Dry-Shake Floor Hardener Finish: After initial floating, apply mineral dry-shake materials to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply mineral dry-shake materials at a rate of 100 lb/100 sq. ft., unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of mineral dry-shake materials over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second mineral dry-shake application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake material manufacturer and apply immediately after final finishing.

3.11 MISCELLANEOUS CONCRETE ITEMS

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

3.12 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

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

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

1. Curing Compound: Apply uniformly to floors and slabs to receive floor coverings. in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Verify with floor coverings manufacturer that curing compound is compatible with floor coverings prior to application of curing compound.

3.13 JOINT FILLING

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

1. Defer joint filling until concrete has aged as long as possible Do not fill joints until construction traffic has permanently ceased.

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

C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

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

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

C. Test repair technique on a mock-up or surface to be concealed later and obtain Professional's approval prior to repairing surfaces.

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

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Professional.

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

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment provided underlayment repair thickness does not exceed 1/4-inch in depth. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Use a repair topping to correct other low areas scheduled to remain exposed or for other low areas scheduled to receive floor coverings but where underlayment thickness repair would exceed 1/4-inch in depth. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair

topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

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

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

3.15 FIELD QUALITY CONTROL

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

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof. Water may not be added to the concrete after the sample is taken.

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

2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
6. Compression Test Specimens: ASTM C 31 cast and laboratory cure one set of ten standard cylinder specimens for each composite sample. Water may not be added to the concrete after the sample is taken.
7. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.

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

B. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

C. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

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

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

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

G. Contractor shall be backcharged for retesting or additional testing of non-complying concrete.

END OF SECTION 03 3000

DIVISION 04

MASONRY

SECTION 04 8100 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU's).
2. Building (common) brick.
3. Hollow brick.

B. Related Sections:

1. Section 05500 "Metal Fabrications" for furnishing steel lintels for unit masonry.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product indicated. For masonry units include data on material properties material test reports substantiating compliance with requirements.

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

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

1.5 QUALITY ASSURANCE

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

1.6 PROJECT CONDITIONS

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

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

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

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

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated for completion of the work.

B. Integral Water Repellent: Provide units made with liquid polymeric, integral water repellent admixture that does not reduce flexural bond strength.

C. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Medium weight.

2.3 BRICK

A. General: Provide shapes indicated and as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: Facing brick complying with ASTM C 216.

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

    a. Glen-Gery Corporation
    b. Triangle Brick Company
    c. Acme Brick Company

2. Grade: SW.
3. Type: FBS.
4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi (23.10 MPa).
5. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
6. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."

7. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m).
8. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.

C. Building (Common) Brick: ASTM C 62, Grade SW.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi (23.10 MPa).
2. Size: Match size of face brick.

D. Hollow Brick: ASTM C 652, Grade SW.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi (23.10 MPa).
2. Size: Match size of face brick.

2.4 MORTAR AND GROUT MATERIALS

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

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

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

D. Masonry Cement: ASTM C 91.

E. Aggregate for Mortar: ASTM C 144.

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

F. Aggregate for Grout: ASTM C 404.

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

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

I. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615 Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
5. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
7. Provide in lengths of not less than 10 feet (3 m).

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized, carbon-steel continuous wire.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

1. Wire: Fabricate from 3/16-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.

D. Partition Top anchors: 0.105-inch- (2.66-mm-) thick metal plate with 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

F. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch- (1.90-mm-) thick steel sheet, galvanized after fabrication.
3. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.
4. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

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

        1) Heckmann Building Products Inc.; 315-D with 316.
        2) Hohmann & Barnard, Inc.; DW-10.
        3) Masonpro, Inc.: Type III.

    b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, having slotted holes for inserting wire tie.

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
2. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
3. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

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

1) Heckmann Building Products Inc.; No. 85 Cell Vent.
2) Hohmann & Barnard, Inc.; Quadro-Vent.
3) Mortar Net USA, Ltd.; Mortar Net Weep Vents.

2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.

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

1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.
2) Heckmann Building Products Inc.; No. 85 Cell Vent.
3) Hohmann & Barnard, Inc.; Quadro-Vent.

3. Vinyl Weep Hole/Vent: T-shaped units made from flexible PVC, consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by professional.

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

1) Hohmann & Barnard, Inc.; #343 Louvered Weep Hole.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

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

a. Mortar Net USA, Ltd.; Mortar Net.
b. Heckmann Building Products Inc.
c. Hohmann & Barnard, Inc.

2. Provide one of the following configurations:

a. Strips, full-depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep.
b. Strips, not less than [3/4 inch (19 mm) thick and 10 inches (250 mm) high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
c. Sheets or strips full depth of cavity and installed to full height of cavity.

2.9 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

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. Diedrich Technologies, Inc.
b. ProSoCo, Inc.

c. Envirosafe Manufacturing Corporation

2.10 MORTAR AND GROUT MIXES

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

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

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

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type N.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

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

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2500 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

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

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
3. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

C. Joints:

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

3.3 LAYING MASONRY WALLS

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

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

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

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

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and CMUs as follows:

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

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

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

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

E. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.

F. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:

1. Provide individual metal ties not more than 8 inches (203 mm) o.c.
2. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.
3. Provide rigid metal anchors not more than 24 inches (610 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.5 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m) of wall area spaced not to exceed 36 inches (914 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

    a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
    b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Parge cavity face of backup wythe in a single coat approximately 3/8 inch (10 mm) thick. Trowel face of parge coat smooth.

D. Coat cavity face of backup wythe to comply with Section 07115 "Bituminous Dampproofing."

E. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and [32 inches (813 mm)] [24 inches (610 mm)] o.c. horizontally with not less than 1 anchor for each [3.5 sq. ft. (0.33 sq. m)] [2.67 sq. ft. (0.25 sq. m)] of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

3.8 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

A. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

B. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

C. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

D. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.9 REINFORCED UNIT MASONRY INSTALLATION

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

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

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

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

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

3.10 REPAIRING, POINTING, AND CLEANING

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

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

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Protect surfaces from contact with cleaner.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

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

3.11 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches of finished grade.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off the property.

END OF SECTION 04 8100

DIVISION 05

METALS

SECTION 05 1200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Structural-steel materials.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shop primer.

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

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify demand-critical welds.
6. Identify members not to be shop primed.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1 for each welded joint qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, and testing agency.

B. Welding certificates.

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

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.

F. Survey of existing conditions.

G. Field quality-control reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

1.9 DELIVERY, STORAGE, AND HANDLING

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

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

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Option 2: Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.

a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
b. Use Allowable Stress Design; data are given at service-load level.

C. Construction: Braced frame.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992 Grade 50.

B. Channels, Angles, M-Shapes: ASTM A36.

C. Plate and Bar: ASTM A36.

D. Cold-Formed Hollow Structural Sections: ASTM A500, Grade C structural tubing.

E. Steel Pipe: ASTM A500, Grade C.

1. Weight Class: as indicated.
2. Finish: Black.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

2.4 PRIMER

A. Steel Primer:

1. Fabricator's Epoxy rust-inhibiting primer complying with MPI#101 and compatible with topcoat.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in

accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Fabricate beams with rolling camber up.
2. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

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

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

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

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

E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

2.7 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces to be field welded.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 3.

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations, sizes, and locations of existing framing, for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include dimensions, beam sizes, locations, and elevations.

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

3.2 COORDINATION DRAWINGS

A. Coordination

1. Each Contractor and sub-contractor shall familiarize himself with the drawings, specifications, and existing site conditions of all other contracts relating to this project and shall coordinate with, and be held responsible for his Work which is affected by or dependent on, other contracts and existing conditions.
2. Each Contractor shall provide any dimension, coordination, sleeve, insert, embedded or built-in item, and/or information which is required to be built into, or to complete, the work of another contract in a manner consistent with the Approved Project Schedule. Any additional cost or delay damages arising from a contractor's failure to so furnish or provide shall be borne by that contractor.

3.3 PREPARATION

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

3.4 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Maintain erection tolerances of structural steel within ANSI/AISC 303.

C. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

D. Splice members only where indicated.

E. Do not use thermal cutting during erection.

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

3.5 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

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

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs[where indicated], back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.6 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.7 FIELD QUALITY CONTROL

B. Testing Agency: Engage a qualified testing agency to perform tests.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.
2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3) Ultrasonic Inspection: ASTM E164.
4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 05 1200

SECTION 05 3100 - STEEL DECKING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. This Section includes the following:

1. Composite floor deck.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for concrete fill and reinforcing steel.
2. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.4 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.

C. Product Certificates: Signed by steel deck manufacturers certifying that products furnished comply with requirements.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:

1. Optional mechanical fasteners. Compare shear and tension capacities of mechanical fasteners to indicated welded connections.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel," and AWS D1.3, "Structural Welding Code - Sheet Steel." All welding shall be performed by certified welders only.

D. AISI Specifications: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."

E. FM Listing: Provide steel roof deck evaluated by FM and listed in FM's "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Steel Deck:

a. Epic Metals Corp.
b. Nucor Corp.; Vulcraft Div.
c. United Steel Deck, Inc.

2.2 COMPOSITE FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 29, the minimum section properties indicated, and the following:

Where indicated in plans and sections provide 3” Composite Floor Deck with the following properties:

1. Galvanized Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G90 zinc coating.
2. Profile Depth: 3 inches.
3. Design Uncoated-Steel Thickness: 16 gauge 0.0598-inch.
4. Span Condition: Triple span or more unless indicated otherwise on structural drawings.

Where indicated in plans and sections provide 3” Composite Floor Deck with the following properties:

1. Galvanized Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G90 zinc coating.
2. Profile Depth: 1 1/2 inches.
3. Design Uncoated-Steel Thickness: 18 gauge 0.0474-inch.
4. Span Condition: Triple span or more unless indicated otherwise on structural drawings.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 18 gauge design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Steel Sheet Accessories: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 29 for overhang and slab depth.

H. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

I. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck are not permitted.

J. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 16 gauge (0.0598 inch) minimum thick, with factory-punched hole of 3/8-inch minimum diameter.

K. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

L. Repair Paint: Lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to the most stringent requirements of applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate decking bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck provided written approval is obtained from the Structural Engineer. Locate mechanical fasteners as specified by Structural Engineer and install according to fastener manufacturer's written instructions.

3.3 FLOOR DECK INSTALLATION

A. Fasten floor deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 5/8-inch, nominal.
2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart unless indicated otherwise on structural drawings.
3. Weld Spacing: Space and locate welds as indicated.
4. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling No. 10 diameter or larger carbon-steel screws.
2. Fasten with a minimum of 1-1/2-inch long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2-inches, with end joints as follows:

1. End Joints: Butted.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

E. Floor Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of decking. Weld cover plates at changes in direction of floor deck panels, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing: Contractor shall engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

F. Extent of Inspection and Testing.

1. Welded Connections:

a. 100 percent of shop-welded connections shall be visually inspected.
b. 100 percent of partial penetration and full penetration type shop welded connections shall be tested by ultrasonic or radiographic inspection.
c. 100 percent of any weld suspected of being defective based on visual inspection shall be tested by ultrasonic or radiographic inspection.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 3100

SECTION 05 5000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.

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

1. Steel Lintels

C. Related Requirements:

1. Section 051200 "Structural Steel Framing" for steel framing, supports, and other steel items attached to the structural-steel framing.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Fasteners.
2. Shop primers.
3. Slotted channel framing.

B. Shop Drawings: Show fabrication and installation details. include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Structural-steel door frames.
3. Miscellaneous steel trim including steel angle corner guards.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

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

D. Research Reports: For post-installed anchors.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

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

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

2.2 METALS

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

B. Steel Plates, Shapes, and Bars: ASTM A36.

C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 316L.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 316L.

E. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

F. Rolled-Stainless Steel Floor Plate: ASTM A793.

G. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches.

2. Galvanized Steel: ASTM A653/A653M, structural steel, Grade 33, with G90 coating; 0.108-inch nominal thickness.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum, stainless steel or nickel silver.
2. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594 and, where indicated, flat washers; Group 2.

D. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.

B. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.5 FABRICATION, GENERAL

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

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of

approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

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

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

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

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

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

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

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

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

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime exterior miscellaneous steel trim.

D. Prime miscellaneous steel trim with zinc-rich primer.

2.8 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.9 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

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

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

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

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

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

1. Shop prime with universal shop primer.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning." requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
4. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

C. Field Welding: Comply with the following requirements:

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

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

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

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AN D SUPPORTS

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

3.3 INSTALLATION OF MISCELLANEOUS STEEL TRIM

A. Anchor to concrete construction to comply with manufacturer's written instructions.

3.4 INSTALLATION OF ABRASIVE METAL NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths unless otherwise indicated.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

3.5 REPAIRS

A. Touchup Painting:

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

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

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 5000

DIVISION 07

THERMAL AND MOISTURE PROTECTION

SECTION 07 9200 – JOINT SEALANTS

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes sealants for the following applications, including those specified by reference to this Section.

B. This Section includes sealants for the following applications:

1. Exterior joints in the following vertical surfaces and horizontal surfaces:

a. Control and expansion joints in cast-in-place concrete and masonry.
b. Joints between different materials.
c. Perimeter joints between materials listed above and frames of doors and windows.
d. Other joints as indicated.

2. Interior joints in the following vertical surfaces and horizontal surfaces:

a. Perimeter joints of exterior openings where indicated.
b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
c. Joints between plumbing fixtures and adjoining walls, floors, and counters.
d. Other joints as indicated.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Samples for Initial Selection: Manufacturer’s color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

D. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI’s Sealant Validation Program.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration data, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F (4.4 deg C).

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

PART 2 – PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following (See Schedule at End of Section).

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

2.4 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, of size and density to control sealant depth and

otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:

    a. Concrete
    b. Masonry

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

    a. Metal
    b. Glass

B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shape and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

E. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

G. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:

1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
2. Apply a bead of silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's printed schedule and covering a bonded area of not less than a 3/8 inch. Hold edge of sealant bead inside of masking tape by 1/4 inch.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of horizontal joints before installing vertical joints. Lap vertical joints over horizontal joints. At end of joints, cut silicone extrusion with a razor knife.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, to produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant to comply with sealant manufacturer's written instructions.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.6 ELASTOMERIC JOINT – SEALANT SCHEDULE

A. Joint sealants: Where joints of this type are indicated, provide products complying with the following:

1. Products:

   a. 3M Company
   b. Dow Corning
   c. Pecora
   d. Tremco

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Additional Movement Capability: 100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement.
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated:

   a. Uses O Joint Substrates: (Coated glass, color anodic aluminum, aluminum coated

with a high –performance coating, galvanized steel, brick, granite, limestone, marble.

7. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.

END OF SECTION 07 9200

DIVISION 08

DOORS AND WINDOWS

SECTION 08 1100 - STEEL DOORS AND FRAMES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes steel doors and frames.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 4 Section "Unit Masonry" for building anchors into and grouting frames in masonry construction.
2. Division 8 Section "Door Hardware" for door hardware and weatherstripping.
3. Division 8 Section "Glazing" for glass in steel doors and sidelights.
4. Division 9 Section "Painting" for field painting primed doors and frames.

1.1 SUBMITTALS

A. Product Data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.

B. Shop Drawings showing fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

C. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.

1. Indicate coordination of glazing frames and stops with glass and glazing requirements.

D. Samples for initial selection in the form of manufacturer's color charts showing the full range of colors available for factory-finished doors and frames.

1.2 QUALITY ASSURANCE

A. Provide doors and frames complying with ANSI/SDI 100 "Recommended Specifications for Standard Steel Doors and Frames" and as specified.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inch- (100-mm-) high wood blocking. Avoid using non vented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Steel Doors and Frames:
   Exterior Doors: Grade III, extra-heavy-duty, minimum 16 gauge galvanized steel, 1¾" thickness.
   Exterior Frames: Welded, 16 gauge galvanized sheet steel, mitered or coped corners.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial-quality carbon steel, pickled and oiled, complying with ASTM A 569 (ASTM A 569M).

B. Cold-Rolled Steel Sheets: Carbon steel complying with ASTM A 366 (ASTM A 366M), commercial quality, or ASTM A 620 (ASTM A 620M), drawing quality, special killed.

C. Galvanized Steel Sheets: Zinc-coated carbon steel complying with ASTM A 526 (ASTM A 526M), commercial quality, or ASTM A 642 (ASTM A 642M), drawing quality, hot-dip galvanized according to ASTM A 525, with A 60 or G 60 (ASTM A 525M, with Z 180 or ZF 180) coating designation, mill phosphatized.

D. Supports and Anchors: Fabricated from not less than 0.0478-inch- (1.2-mm-) thick steel sheet; 0.0516-inch- (1.3-mm-) thick galvanized steel where used with galvanized steel frames.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize complying with ASTM A 153, Class C or D as applicable.

2.3 DOORS

A. Steel Doors: Provide 1-3/4-inch- (44-mm-) thick doors of materials and grades and models specified below, and as indicated on Drawings or schedules.

1. Ceco 16 gauge cold rolled steel with 20 gauge vertical steel stiffeners at 6" apart welded to face sheets, 12 gauge closer reinforcement steel support, 16 gauge channel perimeter frame, hot-dipped galvanized for exterior doors.

2.4 FRAMES

A. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, according to ANSI/SDI 100, and of types and styles as shown on Drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames of minimum 16 gauge thick cold-rolled steel sheet.

1. Fabricate frames with mitered or coped corners, continuously welded construction for

exterior applications and interior applications.

2. Form all exterior and interior frames from 16 gauge thick steel sheet. Exterior frames shall be galvanized.

B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.

C. Plaster Guards: Provide minimum 0.0179-inch- (0.45-mm-) thick steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

D. Grout: When required in masonry construction, as specified in Division 4 Section "Unit Masonry."

2.5 FABRICATION

A. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Comply with ANSI/SDI 100 requirements.

1. Internal Construction: One of the following manufacturer's standard core materials according to SDI standards:

   a. Rigid polyurethane conforming to ASTM C 591 - Exterior doors.
   b. Rigid polystyrene conforming to ASTM C 578- Interior doors.

2. Clearances: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between non-fire-rated pairs of doors. Not more than 3/4 inch (19 mm) at bottom.

B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel sheet.

C. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

E. Galvanized Steel Doors, Panels, and Frames: For the following locations, fabricate doors, panels, and frames from galvanized steel sheet according to SDI 112. Close top and bottom edges of doors flush as an integral part of door construction or by addition of minimum 0.0635- inch- (1.6-mm-) thick galvanized steel channels, with channel webs placed even with top and bottom edges. Seal joints in top edges of doors against water penetration.

1. At exterior locations and where indicated.

F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

G. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to ASTM C 236 or ASTM C 976 on fully operable door assemblies.

1. Unless otherwise indicated, provide thermal-rated assemblies with U-value rating of

0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K) or better.

H. Sound-Rated (Acoustical) Assemblies: Where shown or scheduled, provide door and frame assemblies fabricated as sound-reducing type, tested according to ASTM E 1408, and classified according to ASTM E 413.

1. Unless otherwise indicated, provide acoustical assemblies with STC sound ratings of 33 or better.

I. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of SDI 107 and ANSI A115 Series specifications for door and frame preparation for hardware.

J. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

K. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

L. Glazing Stops: Minimum 0.0359-inch- (0.9-mm-) thick steel or 0.040-inch- (1-mm-) thick aluminum.

1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
2. Provide screw-applied, removable, glazing beads on inside of glass, louvers, and other panels in doors.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations relative to applying and designating finishes.

B. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for steel sheet finishes.

C. Apply primers and organic finishes to doors and frames after fabrication.

2.7 GALVANIZED STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces with nonpetroleum solvent so that surfaces are free of oil or other contaminants. After cleaning, apply a conversion coating of the type suited to the organic coating applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight and complying with DOD-P-21035 or SSPC-Paint 20.

B. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply air-dried primer specified below immediately after cleaning and pretreatment.

1. Shop Primer: Zinc-dust, zinc-oxide primer paint complying with performance requirements of FS TT-P-641, Type II.

2.8 STEEL SHEET FINISHES

A. Surface Preparation: Solvent-clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel to comply with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC- SP 8 (Pickling).

B. Pretreatment: Immediately after surface preparation, apply a conversion coating of type suited to organic coating applied over it.

C. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A224.1 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
2. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.

C. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.

3.2 ADJUSTING AND CLEANING

A. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08 1100

SECTION 08 3320 - ROLLING SERVICE DOORS

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. Insulated rolling service doors.

1.3 RELATED SECTIONS

A. Section 055000 - Metal Fabrications: Support framing and framed opening.

B. Section 260533 - Raceway and Boxes: Conduit from electric circuit to door operator and from door operator to control station.

C. Section 260519 - Low voltage Electrical Power Conductors.

1.4 REFERENCES

A. ANSI/DASMA 108 - American National Standards Institute Standard Method For Testing Sectional Garage Doors And Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.

B. NFRC 102 - Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.

C. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

D. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

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

F. NEMA MG 1 - Motors and Generators.

1.5 DESIGN / PERFORMANCE REQUIREMENTS

A. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.6 SUBMITTALS

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

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.
3. Details of construction and fabrication.
4. Installation instructions.

B. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.

C. Representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

F. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.

B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

C. Store materials in a dry, warm, ventilated weathertight location.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 COORDINATION

A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.11 WARRANTY

A. Warranty: Manufacturer’s limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.

B. Warranty: Manufacturer’s limited door system warranty for 2 years for all parts and components.

C. PowderGuard Finish

1. PowderGuard Premium Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Premium Finish warranty for 2 years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Overhead Door Corporation, 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com.

B. Substitutions: Equal products approved by the Engineer.

C. Acceptable manufacturers:

1. Clopay Corporation
2. Raynor Garage Doors
3. Amarr Commercial Doors

2.2 INSULATED ROLLING SERVICE DOORS

A. Stormtite Insulated Rolling Service Doors: Overhead Door Corporation Model 625.

1. Curtain: Interlocking roll-formed slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.

a. Flat profile type F-265i for doors up to 40 feet (12.19 m) wide.
b. Front slat fabricated of:

1) 24 gauge galvanized steel.

c. Back slat fabricated of:

1) 24 gauge galvanized steel.

d. Slat cavity filled with CFC-free foamed-in-place, polyurethane insulation.

1) R-Value: 7.7, U-Value: 0.13.

2. Performance:

a. Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90.
b. Installed System Sound Rating: STC-21 as per ASTM E 90.
c. U-factor: 0.91 NFRC test report, maximum U-factor of no higher than 1.00.
d. Air Infiltration: Meets ASHRAE 90.1 & IECC 2012/2015 C402.4.3 Air leakage <1.00 cfm/ft2.

3. Slats and Hood Finish:

a. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.

1) Polyester Top Coat:

(a) Gray polyester.
(b) Tan polyester.
(c) White polyester.
(d) Brown polyester.

2) Powder Coat:

(a) PowderGuard Premium powder coat color as selected by the Professional.
(b) PowderGuard Textured powder coat color as selected by the Professional.
(c) PowderGuard Max powder coat, color as selected by the Professional.

3) Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.

4. Weatherseals:

a. Vinyl bottom seal, exterior guide and internal hood seals.
b. Interior guide weatherseal.
c. Lintel weatherseal.

5. Bottom Bar:

a. Two galvanized steel angles minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.

6. Guides: Three structural steel angles.
7. Brackets:

a. Galvanized steel to support counterbalance, curtain and hood.

8. Finish; Bottom Bar, Guides, Headplate and Brackets:

a. PowderGuard Premium powder coat in black color.

9. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel.
10. Hood: Provide with internal hood baffle weatherseal.

a. 24 gauge galvanized steel with intermediate supports as required.

11. Manual Operation:

a. Chain hoist.

12. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.

a. Sensing Edge Protection:

1) Electric sensing edge.

b. Operator Controls:

1) Push-button operated control stations with open, close, and stop buttons.
2) Controls for interior location.
3) Controls surface mounted.

c. Special Operation:

1) Photocell operation.

d. Motor Voltage: 115/230 single phase, 60 Hz.

13. Wind Load Design:

a. Standard wind load shall be 30 PSF.

14. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.
15. Locking:

a. Chain keeper locks for chain hoist operation.
b. Interior slide bolt lock for electric operation with interlock switch.
c. Cylinder lock for electric operation with interlock switch.

16. Wall Mounting Condition:

a. Face-of-wall mounting.

B. DuraCoil as manufactured by Raynor Garage Doors.

1. Doors:

a. Operation:

1) Provide doors designed for push-up operation.
2) Provide doors designed for hand chain operation.
3) Provide doors designed for electric motor operation.

b. Mounting: Door guide mounting configuration.

1) Interior face of wall on each side of door opening.
2) Exterior face of wall on each side of door opening.

c. Structural Performance Requirements:

1) Wind Loads: Uniform pressure of 30 psf.

d. International Energy Conservation Code (IECC) Requirements:

1) Air Infiltration – Maximum air leakage of 1.00 cfm/ft2 is required. Testing shall be in accordance with DASMA 105 test procedure.
2) DuraCoil with insulated slats and header seal provides air leakage rating of .47 cfm/ft2.

e. Sound Transmission Class (STC) rating

1) STC rating of 23 required on an insulated door with header seal.

2. Curtain: Interlocking roll-formed slats as specified below. Endlocks shall be attached to each of alternate slat to prevent lateral movement.

   a. Slat Type(s):

      1) Flat slats

         a) Steel 24 gauge (0.023 inch minimum thickness).

      2) Insulated flat slats with 24 gauge backer (22 gauge optional). Polyisocyanurate insulation with R-value 6.24.

         a) Steel 24 gauge (0.023 inch minimum thickness)

   b. Material:

      1) Commercial quality hot-dipped galvanized (G-90) steel in accordance with ASTM A-653.

   c. Color and Finish:

      1) One finish coat of gray polyester paint applied over one coat of primer.
      2) One finish coat of tan polyester paint applied over one coat of primer.
      3) One finish coat of white polyester paint applied over one coat of primer.
      4) ArmorBrite Powdercoat finish. Color as selected by the Professional.

3. Endlocks: Zinc-plated malleable cast iron endlocks fastened with two zinc-plated steel rivets.
4. Bottom Bar: Two angles, minimum 1-1/2 inches by 1-1/2 inches by 1/8 inch (38.1 mm x 38.1 mm x 3.2 mm) with single-contact type bottom astragal.

   a. Material:

      1) Structural steel angles.

   b. Color and finish:

      1) ArmorBrite Powdercoat finish. Color as selected by the Professional.

5. Guide Assemblies: Three structural angles, minimum 3 inches by 2 inches by 3/16 inch (76 mm by 50.8 mm by 4.8 mm) and fitted with removable curtain stops.

   a. Material and Finish:

      1) Structural steel to receive ArmorBrite Powdercoat finish. Color as selected by the Professional.

6. Guide Weatherseal: Seals to inhibit air infiltration between the guide and the curtain.

      1) Snap-on dual durometer vinyl seal.

7. Counterbalance: Barrel: Minimum 4-1/2 inches (114.3 mm) O.D. and 0.120 inch (3.1 m) wall thickness structural steel pipe. Deflection of pipe under full load shall not exceed 0.03 inch (0.8 mm) per foot of span.

a. Counterbalance: Provide counterbalance mechanism with helical torsion springs, grease packed and mounted on a continuous steel torsion shaft.

1) Standard 15,000 cycles.

8. Brackets: 3/16 inch (4.8 mm), minimum, steel plate, attached to wall angle of guide assembly with 1/2 inch (12.7 mm) diameter Grade 5 bolts. Inside of drive bracket fitted with sealed ball bearing.

a. Finish:

1) Provide brackets with one coat of ArmorBrite Powdercoat finish. Color as selected by the Professional.

9. Enclosures:

a. Hood Type:

1) Round Hood.

b. Bracket Covers: Covers to enclose door mechanisms.
c. Material:

1) 24 gauge steel (0.022 inch minimum thickness) commercial quality hot-dipped galvanized steel in accordance with ASTM A-653.

c. Color and Finish:

1) ArmorBrite Powdercoat finish. Color as selected by the Professional.

d. Hood Baffle: Provide hood baffle with a rubber seal to inhibit air infiltration through hood cavity.

10. Header Seal: Provide a “Z” shape aluminum retainer with EDPM rubber to inhibit air infiltration between the header and the curtain.
11. Locks: Furnish door system with the following:

a. Locking Bar: For push-up doors and doors operated with hand chain to receive padlock provided by Client Agency.
b. Locking Bar for Motor Operated Doors: Provide interlock switch with locking bar.
c. Hand Chain Lock: To receive padlock provided by Client Agency; for doors operated with hand chain.

12. Electric Operators ControlHoist (UL Listed) as manufactured by Raynor Garage Doors:

a. Model: Raynor ControlHoist Optima:

1) Type: Jackshaft with manual chain hoist.
2) Motor Horsepower Rating: Per the manufacturer’s recommended size for door.
3) Electrical Requirements: 115 volt single phase.
4) Electrical Requirements: 230 volt single phase.
5) Control Wiring: Solid state circuitry with provisions for connection of a monitored reversing device, external radio control hook-up and maximum run

timer. Provisions for timers to close and mid stop and lock bar sensor capability.

a) Provide three button momentary contact "open-stop", constant pressure on close (can be changed to momentary to close).
b) Monitored electric reversing edge on door.
c) Monitored photo electric eyes mounted on jambs.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify opening sizes, tolerances and conditions are acceptable.

B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.

C. If substrate preparation is the responsibility of another installer, notify the professional of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Section 260500. Complete wiring from disconnect to unit components.

F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 079200.

G. Install perimeter trim and closures.

H. Instruct facility personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING

A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.

B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.

B. Remove labels and visible markings.

C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

A. Protect installed products until completion of project

END OF SECTION 08 3323

SECTION 08 7100 – DOOR HARDWARE

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. Hardware for steel doors

1.3 RELATED SECTIONS

A. Section 08 1100 – Steel Doors and Frames.

1.4 REFERENCES

A. BHMA A156.1 – Standard for Butts and Hinges; 2006.

B. BHMA A156.3 – Standard for Exit Devices; 2008.

C. BHMA A156.22 – Standard for Door Gasketing Systems; 2005.

1.5 SUBMITTALS

A. Shop Drawings:

1. All submittals to be submitted and processed through eBuilder. Submit a hardware schedule in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Schedules which do not comply will be returned for correction before checking. The hardware schedule shall clearly indicate the professional's hardware set and manufacturer of each proposed item. The schedule shall be reviewed prior to submission by a certified Architectural Hardware Consultant, who shall affix his or her seal attesting to the completeness and correctness of the hardware schedule.
2. Provide two (2) copies of illustrations from the manufacturers catalogs and data in brochure form.
3. Check specified hardware for suitability and adaptability to details and surrounding conditions. Indicate unsuitable items and proposed substitutions in the hardware schedule.
4. Furnish hardware samples for design and finish as requested by the professional. These samples may remain part of the project as long as product is protected from damage and remain in new condition.

B. Manufacturers Installation Instructions:

1. Provide manufacturers written installation and adjustment instructions for each item of hardware. Send installation instructions to the site with hardware.

C. Maintenance Data:

1. Submit through eBuilder operating and maintenance manuals containing the following information:

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

D. Keys and Cylinder Cores:

1. Provide Best interchangeable 7-pin cylinder cores to using agency for keying and installation by the facility.

E. Warranty:

1. Submit manufacturers' written warranty and assure that forms have been completed in the using agency's name and registered with the manufacturer.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with the following requirements:

B. Manufacturers Qualifications: Company specializing in manufacturing the products specified in this section with a minimum of ten (10) years of documented experience. Obtain each item of hardware (i.e. hinges, latch and locksets, exit devices, closers) from a single manufacturer, although several may be indicated as offering products complying with requirements.

C. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with a minimum of ten (10) years of documented experience. The hardware supplier shall have warehousing facilities with-in 100 miles of the project and employ a certified Architectural Hardware Consultant. This consultant shall be available to the professional and the .1 general contractor during normal operating hours.

D. Substitutions: Manufacturers and model numbers listed are to establish a standard of quality and design. Any substitution of products not listed in the specifications must be approved by the architect ten (10) days prior to bid date to allow sufficient time for addendum to be added to the bid documents. All requests are to be in accordance with Division 1, General Requirements and are to be in writing, hand delivered to the professional. All requests are to be accompanied by three (3) copies of the manufacturers brochures and a physical sample of each item in the appropriate design and finish.

E. Six (6) months after substantial completion of the project a factory representative of the provided material shall perform a jobsite walk through. This will be done to determine if products are performing as recommended by the manufacturer and meet all fire and life safety requirements. Deficiencies due to installation shall be corrected by the general contractor and defective material shall be replaced by the hardware distributor.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable code for requirements pertaining to fire rated doors and frames.

B. All Hardware on Fire Rated Doors: Listed and classified by UL as suitable for the purpose specified and indicated.

1.8 PRE-INSTALLATION MEETING

A. Prior to installation of the hardware, manufacturer's representatives for locksets, exit devices and closers shall arrange and hold a jobsite meeting to instruct the installing contractor's personnel on the proper installation of their respective products. A letter of compliance, indicating when this meeting is held and who is in attendance, shall be sent to the professional.

1.9 DELIVERY, STORAGE, AND PROTECTION

A. Package hardware items individually; label and identify each package with door number and hardware item code to match the hardware schedule.

B. Deliver, store and handle packaged hardware to prevent damage to finishes and deterioration in the product due to the elements.

C. Inventory door hardware upon receipt and provide a secure lock-up. Only allow authorized personal to enter.

1.10 COORDINATION

A. Coordinate the work with other trades directly affected involving the manufacture or fabrication of internal reinforcement for door hardware.

B. Furnish two (2) complete sets of templates for door and frame preparation with copies of the final approved hardware schedule. Submit necessary templates and schedules as soon as possible to the hollow metal, wood door and aluminum door (if applicable) fabricators so as not to delay production.

1.11 WARRANTY

A. The warranty period shall be one (1) year from the date of substantial completion for all items of hardware unless noted otherwise.

B. The warranty period for exit devices shall be five (5) years from the date of substantial completion.

C. The warranty period for manual door closers shall be ten (10) years from the date of substantial completion.

D. All manufacturer's screws and attachments supplied with each hardware item must be installed to maintain the warranty.

1.12 MAINTENANCE PRODUCTS

A. Provide special wrenches and tools as applicable to each different or special hardware component.

B. Provide maintenance tools and accessories supplied by the hardware component manufacturer.

C. Furnish three (3) dozen extra screws and other fasteners of each size, type and finish used with the hardware items provided. These screws and fasteners are to be delivered to the hardware installer for use during installation. All extra screws and fasteners and all special installation tools furnished with the hardware shall be turned over to the faclity at the completion of the project.

PART 2 – PRODUCTS

2.1 PREFERRED MANUFACTURERS FOR DOOR HARDWARE BY APPLICATION

A. Hinges: Hager, Ives, McKinney Co. Model BB #1279 ball bearing butt hinge – 180 degree swing.

B. Locksets: Best, Schlage, Yale Model 1800 with trim.

C. Lock Cylinders: Best interchangeable 7-pin core. – No substitutions.

D. Closers: LCN, Von Duprin, Yale Model 270802.

E. Silencers: Pemko, Rockwood, Ives Glynn-Johnson No. GJ64.

2.2 GENERAL REQUIREMENTS FOR DOOR HARDWARE PRODUCTS

A. Provide products that comply with the following:

1. Applicable provisions of Federal, State and local codes.
2. All hardware on fire rated doors and frames as listed and classified by UL as suitable for the purpose specified and indicated.

B. Finishes: US 26D.

2.3 HINGES

A. Provide hinges as specified in the hardware sets, with the following provisions:

1. Provide ball bearing non-removable pin (NRP) feature, utilizing a pointed set screw, at interior openings and where listed in the hardware sets.
2. Provide hinges of original manufacturer only. Aftermarket or third party modification and/or electrification of hinges is not acceptable.
3. Screws shall be flat-head Phillips finished to match the hinge.
4. Drill 5/32 inch hole and use No. 12 x 1-1/4 inch steel threaded to the head wood screws provided by the manufacturer for wood doors.

2.4 CYLINDRICAL LOCKSETS

A. Provide lock functions and trim as specified in the hardware sets, with the following provisions:

1. Backsets: 2-3/4 inches.
2. Locks shall have field adjustable, beveled armored front, with a 1/8 inch thickness minimum.
3. Cylinders shall be manufacturers' restricted keyway, patented or high security removable core, seven pin compatible, meeting the requirements of UL437.
4. Latchbolt shall be solid one-piece ¾ inch throw anti-friction stainless steel.
5. Deadbolt shall be a full one inch throw made of stainless steel and have two (2) hardened steel roller inserts.
6. Strikes: Provide wrought boxes and strikes with proper lip length to protect trim but not to project more than 1/8 inch beyond trim, frame or inactive leaf.

2.5 KEYING

A. Contractor shall provide Best interchangeable 7-pin cores for keying and installation to the using agency for keying and installation.

B. The general contractor shall review the key system with the facility's representative after all of the operating keys have been tested in all cylinders by the general contractor, and the construction cores removed.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that doors and frames are ready to receive work and dimensions are as instructed by the manufacturer.

B. The general contractor shall ensure that the building is secured and free from weather elements prior to installing interior hardware. Examine hardware before installation to ensure it is free from defects.

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

3.2 INSTALLATION

A. Install hardware in accordance with the manufacturers instructions and applicable codes. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in any other way, coordinate removal, storage and reinstallation or application of surface protection with finishing work specified in Division 9 sections. Do not install surface mounted items until finishes have been completed on the substrates involved.

B. Use templates provided by the hardware item manufacturer.

C. Install hardware on fire rated doors and frames in accordance with code and NFPA 80.

D. Set units level. Plumb and true to line and location. Adjust and reinforce attachment to substrate as necessary for proper installation and operation.

E. Mounting heights for hardware from finished floor to centerline of hardware item:

1. For steel doors and frames and wood doors comply with DHI Recommended Locations for Architectural Hardware for Steel Doors and Frames.
2. Hardware locations for steel and wood doors shall be the same.

3.3 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilation equipment, and to comply with referenced accessibility requirements.

B. Clean hardware surfaces soiled by installation or by work in adjacent areas.

C. Instruct Leidos Biomedical Research’s personnel in proper adjustment and maintenance of hardware and hardware finishes during final adjustment and cleaning of hardware.

3.4 PROTECTION OF FINISHED WORK

A. Do not permit adjacent work to damage door hardware or finish.

3.5 DOOR HARDWARE SCHEDULE

Hardware Set #1	Qty.	Description	Model No.	Finish	MFR.
Single door	3	Hinges	MPB79 4 1/2” x 4 1/2”	US26D	McKinney
Exterior	1	Rim Exit Device	1800 AU446F	689	Yale
Exit	1	Closer	2701	689	Yale
	1	Threshold	171A36”	-	Pemko
	1	Gasketing	303AV x 36” x 84”	-	Pemko
	1	Sweep	18100CBN x 36”	-	Pemko

END OF SECTION 08 7100

DIVISION 09

FINISHES

SECTION 09 9000 – PAINTING

PART 1 – GENERAL

1.1 RELATED DOCUMENT

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes surface preparation and field painting of the following:

1. Exposed exterior items and surfaces.
2. Exposed interior items and surfaces.
3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect/Engineer will select from standard colors and finishes available.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and UL, FM, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer’s catalog number and general classification.
2. Manufacturer Information: Provide manufacturer’s technical information, including label analysis and instructions for handling, storing, and applying each coat material proposed for use.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperature continuously maintained at not less than 45 degrees F (7 degrees C).

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.7 PROJECT CONDITIONS

A. Apply paint only when temperature of surfaces to be painted and ambient air temperature are between 50 and 95 degrees F (10 and 35 degrees C)

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F (3 degrees C) above the dew point; or to damp or wet surfaces.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 2 gallons of each material and color applied.

1.9 REQUIREMENTS

A. All work must be thoroughly dry and seasoned before any paint is applied. No exterior work shall be done when rain is falling, during fog, or until dew or moisture which may be on the surface has completely disappeared. All paint shall be applied only within limits of temperature and relative humidity recommended by paint manufacturer.

B. All adjacent work shall be protected from paint droppings, spatters, etc., by the use of drop cloths. All damaged work caused by lack of or improper protection on the part of the contractor shall be restored at his own expense. All oily rags and waste shall be kept in covered metal containers and removed daily from the building with rubbish, empty cans, etc., to prevent accumulation of material which will endanger the building from spontaneous combustion.

C. Provide all scaffolds, staging, etc., required for proper execution of work.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for exterior and interior paint systems is based on products scheduled manufactured Sherwin-Williams Company Promar 200. Subject to compliance with aesthetic and specified requirements, manufacturers offering comparable products that may be incorporated into the Work include, subject to Architect's/Engineer's approval, but not limited to the following:

1. Sherwin-Williams
2. PPG Architectural Coatings
3. Benjamin Moore & Co.

2.2 PAINT, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quantity: Provide manufacturer's best-quality paint material of the various coating

types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

C. Colors: Provide color selections made by the Architect/Engineer.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent
2. Masonry (Clay and CMU): 12 percent
3. Wood: 15 percent

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATIONS

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be paint exceeds that permitted in manufacturer's written instructions.

E. Clay Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content of surfaces or alkalinity of mortar joints to be painted exceed that permitted in manufacturer's written instructions.

F. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

G. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove surface oxidation.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backside of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoat or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

1. Mechanical Work:

a. Uninsulated metal piping.
b. Uninsulated plastic piping.
c. Pipe hangers and supports.
d. Tanks that do not have factory-applied final finishes.
e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
f. Duct equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:

a. Switchgear.
b. Panelboards.

c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Using agency's reserves the right to invoke the following procedure at any time and as often as the using agency deems necessary during the period when paints are being applied:

1. The general contractor will engage the services of qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements.
3. Architect may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 SCHEDULE OF PAINTING

A. Exterior Metal:

1. Latex Systems

a. Gloss Finish

1) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Metal Primer, B66-310 Series (5-10 mils wet, 2-4 mils dry)
2) 2nd Coat: S-W Pro Industrial 0VOC Acrylic Gloss, B66-600 Series
3) 3rd Coat: S-W Pro Industrial 0VOC Acrylic Gloss, B66-600 Series (6-12 mils wet, 2.5-4.0 mils dry per coat)

2. Items of metal work to receive the above finish shall include but not necessarily limited to the following:

a. Ferrous metal door frames and doors
b. Lintels
c. Bollards
d. Steel angle door framing

e. Ladders, structural supports, etc.
f. All exposed miscellaneous ferrous metal items not listed elsewhere to be painted

B. Interior Metal:

1. Latex Systems

a. Gloss Finish

1) 1st Coat: S-W Pro Industrial Pro-Cryl Universal Metal Primer, B66-310 Series (5-10 mils wet, 2-4 mils dry)
2) 2nd Coat: S-W Pro Industrial 0VOC Acrylic Gloss, B66-600 Series
3) 3rd Coat: S-W Pro Industrial 0VOC Acrylic Gloss, B66-600 Series (6-12 mils wet, 2.5-4.0 mils dry per coat)

2. Prime coat shall be tinted to approximate color of finish coat where product permits.
3. Items of metal work to receive the above finish shall include but not necessarily limited to the following:

a. Ferrous metal door frames and doors, including but not limited to, door frames and doors, and ferrous metal louvers in existing sidelites. (Note: aluminum door frames shall not be painted)
b. Lintels
c. Exposed steel columns
d. Handrails and railings, as well as, all exposed metal work within stairs and landings.
e. Access panels
f. Electrical panel covers
g. Exposed conduit
h. Surface electrical raceway
i. Exposed gas piping shall receive one (1) coat of Safety Yellow Ironclad Q. D. Industrial Enamel No 071, or PPG Pittsburgh Paints 6-282 series Industrial Gloss Enamel colored to Safety Yellow.

C. Interior Masonry (CMU)

1. Latex Systems (Water Base):

a. 1st Coat: SW Promar 200 Paint and Primer (5-7 mils wet, 2-3 mils dry per coat)
b. 2nd Coat: SW Promar 200 Paint and Primer (15 mils per coat)

D. Miscellaneous Items to be Painted:

1. Paint the inside of all vent and heat ducts, directly back of the grilles where exposed to view with one (1) coat of flat black paint.
2. Touch-up Structural Steel: After field erection, all rivets, bolts, welded, burned edges and abraded surfaces on structural steel, steel joist and steel deck shall be repainted with the same type of paint used for shop coat. All tar pitch or other objectionable material shall be removed before touch-up paint is applied. No bare spots of steel with be acceptable.

3.7 CLEANING AND COMPLETION WORK

A. Just prior to final acceptance and completion, the contractor shall examine all painted and finished surfaces and retouch or refinish as necessary and required to leave all surfaces in

perfect condition.

END OF SECTION 09 9000

DIVISION 23

HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 0505 – HVAC SCOPE

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 EQUIPMENT AND SYSTEMS PACKAGING

A. Equipment and product manufacturers specified in the Section 23 documents are encouraged to form vendor teams where practical to provide equipment in competitively priced packages.

1.4 DESCRIPTION OF WORK

A. The work to be performed under these Specifications and the accompanying Drawings comprises the furnishing of the labor, materials, tools, and other services and facilities necessary for the complete installation of, but not necessarily limited to the following:

1. Furnish and install new boilers B-2, B-3 and B-6 with associated piping, breeching, equipment, wiring, etc.
2. Furnish and install new combination deaerator and surge tank DA-2 with associated piping, pumps, wiring, etc. Existing DA tank will remain for backup.
3. Demolition of existing undersized flash tank. Furnish and install new appropriately sized flash tank with associated piping.
4. Furnish and install new steam meter on steam main in tunnel.
5. Demolition of existing boiler control panels. Furnish and install new boiler control panels.
6. Furnish and install secondary HPS line from steam header to connection point in basement. Secondary steam line will have shutoff valve. – **Base Bid 3**
7. Furnish and install emergency port connections form the steam system, gas and oil piping to termination point shown on drawings for emergency boiler. – **Base Bid 3**
8. Furnish and install new steam blowdown separator and associated piping. – **Base Bid 4**
9. Furnish and install new VFDs for sewer pumps in basement. – **Base Bid 4**
10. Furnish and install new VFDs for existing boiler feed pumps. – **Base Bid 4**
11. Furnish and install new dual fuel burner on existing boiler B-4 for gas and oil fired operation. – **Base Bid No. 5**
12. Demolish and remove existing fuel oil pump assembly. **– Base Bid 5**
13. Furnish and install new fuel oil pump assembly. **– Base Bid 5**

1.5 WORK BY OTHERS

A. The following construction and equipment related to the work under this Contract will be provided by others:

1. Openings in exterior walls. (General Contractor)
2. The removal of existing electrical wiring, conduit and boxes for existing removed heating and ventilating equipment. (Electrical Contractor)

3. The line and load side electric power wiring to the new electrically operated heating, ventilating and air conditioning equipment (Electrical Contractor). The control and interlock wiring, both low and line voltage shall be included under the HVAC Contract as hereinafter specified for the HVAC equipment.
4. The Electrical Contractor shall be responsible for the power wiring and associated terminations to line and load side as well as mounting of the combination starter/disconnects, magnetic starters, VFD's, manual starters, disconnect switches, etc. furnished by the mechanical contractor and external to equipment they are designated to serve. The Electrical Contractor shall make final connections to the equipment as directed by the Mechanical Contractor.

PART 2 – PRODUCTS

2.1 NOT APPLICABLE TO THIS SECTION

PART 3 - EXECUTION

3.1 NOT APPLICABLE TO THIS SECTION

END OF SECTION 23 0505

SECTION 23 0506 - BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 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.

1.3 DEFINITIONS

A. The word "building" used throughout these specifications shall be interpreted to mean the entire Building Complex.

B. The term “The Professional” shall refer to the Engineer.

C. Where the phrase "or approved equivalent," "or equivalent" or "approved" appears in these specifications, it shall refer to the approval of the Professional on the material or equipment involved.

D. The term "0.2 Contractor" mentioned in these specifications refers to Contractor responsible for the work and equipment included in these specifications.

E. The term "0.1 Contractor" mentioned in these specifications refers to the General Contractor.

F. The term "0.3 Contractor" mentioned in these specifications refers to the Plumbing Contractor.

G. The term "0.4 Contractor" mentioned in these specifications refers to the Electrical Contractor.

1.4 CODES AND STANDARDS

A. The work shall be executed, and the equipment constructed and installed in accordance with the requirements of the State Building Code, the Department of Labor and Industry, ASME, Department of Environmental Resources, Department of Labor, Safety and Health Regulations for Construction, OSHA, National Fire Protection Association, the National Electrical Code as amended to date of bidding, and applicable federal, state, county and local ordinances and regulations.

B. Nothing contained in these specifications or shown on the drawings shall be construed to conflict with the aforesaid codes, ordinances, or regulations.

1.5 PERMITS AND CERTIFICATES

A. The fees and permits required shall be satisfied and obtained by the 0.2 Contractor and the cost shall be included in the Contract price.

B. Certificates of approval shall be obtained from any department issuing same and shall be turned over to the Client Agency at the completion of the work.

1.6 QUESTIONS AND CLARIFICATIONS OF BID DOCUMENTS

A. Bidders shall not rely on any verbal clarification of the Drawings and Specifications.

B. Any questions or clarifications shall be referred to the Professional at least seven (7) working days prior to bidding to allow for issuance of an addendum.

1.7 GENERAL REQUIREMENTS

A. **No piping, ductwork or equipment shall be installed without first obtaining sign off from the other trades. Should such installation occur, and then subsequent conflicts arise, this Contractor shall, at his own expense, remove that which is in conflict and reinstall appropriately.**

B. The 0.2 Contractor shall visit the site and thoroughly acquaint himself with conditions existing at the site before submitting his proposal as he will be held responsible for the complete installation of the work in every detail.

C. The 0.2 Contractor shall carefully examine the general building drawings, and the mechanical and electrical drawings, and carry on his work so as not to delay or interfere with the work of other trades. He shall obtain in writing from the other contractors such data as is necessary to coordinate his work with other trades.

D. Carefully examine the drawings included under this Contract and drawings included under other contracts and report any discrepancies noticed to the Professional as this contractor shall be responsible for the HVAC system installation in its entirety.

E. The drawings are diagrammatic and generally indicative of the work to be installed. Due to the small scale of the drawings, it is not possible to indicate all offsets, fittings, valves, dampers, access panels, and similar parts which may be required. The 0.2 Contractor shall carefully investigate the structural and finish conditions affecting the work and arrange his work, accordingly, furnishing necessary parts and equipment as may be required to meet the various conditions.

F. The work shown on the drawings and not specifically included in the specifications shall be considered a part of the Contract work. The work included in the specifications and not specifically included on the drawings shall also be considered a part of the Contract work.

G. The 0.2 Contractor will be responsible for the completion of the work included under this Contract and shall employ skilled and qualified tradesmen as necessary to satisfactorily complete the work and trades.

H. The work shall be installed subject to the approval of the Professional.

1.8 SCHEDULE OF WORK

A. The 0.2 Contractor shall arrange his work to comply with the project schedule and the published or revised phasing schedule.

B. The 0.2 Contractor shall submit a complete schedule of work to e-Builder for review and approval by the Professional at the beginning of the Contract in accordance with the phasing schedule.

C. The schedule shall clearly indicate the proposed order in which the various parts of the work will be undertaken, and the estimated time required for the completion of each part of the work.

D. The work shall be coordinated with work being performed by contractors of other trades, with the

Client Agency and phasing schedule.

E. The installation of equipment shall follow the phasing schedule.

F. The 0.2 Contractor shall especially review the phasing schedule and ensure compliance with this schedule.

G. The schedule of work may be revised periodically during the course of construction, but each revised schedule must be approved by the Professional.

1.9 SHOP DRAWINGS AND SUBMITTALS

A. Refer to Professional's Division 01 specifications for submittal requirements.

B. A complete list of materials proposed for each installation shall be submitted to e-Builder for the Professional for review and approve before delivery to the site.

C. Prior to the installation of any equipment or materials, submit shop drawings and manufacturer's data for the items listed in the Submittal Register in e-Builder in accordance with the Contract Documents.

D. The Submittal Register in e-Builder shall serve as the 0.2 Contractor's checklist to assure the complete submission of the required shop drawings and manufacturer's data.

E. Equipment and materials furnished as part of this Contract shall be submitted for review whether listed on Submittal Register in e-Builder or not.

F. It is the 0.2 Contractor's responsibility to check his own submissions for compliance with the Contract Documents and job conditions.

G. **Any deviations from the design documents must be clearly identified so that the Professional may properly review such items.** It shall not be the Professional's responsibility to search out these deviations. If such deviations are not properly flagged for the Professional's review, The 0.2 Contractor shall be completely responsible for the consequences that might result from the deviations.

H. The 0.2 Contractor shall submit samples of materials for approval at the site as requested by the Professional. Such materials may be incorporated into the structures after serving their purpose as samples.

I. At the close of the job, prior to final review, one (1) PDF of operations and maintenance (O&M) manuals shall be submitted to e-Builder for review and approval by the Professional. O&M manuals shall include the following:

1. Equipment warranties.
2. Contractors' warranties.
3. Parts list and manuals for the equipment.
4. Operating instructions (in writing).
5. Written instructions on maintenance and care of the systems.
6. Lubrication and recommended spare parts.

J. Submit Record (As-Built) Drawings. Refer to Paragraph 3.3

1.10 DRAWING DIMENSIONS, GRADES, AND ELEVATIONS

A. The 0.2 Contractor shall layout his work from dimensions of Architectural and Structural Drawings

and actual dimensions of equipment being installed.

B. Layouts in congested areas should not be scaled from Mechanical and Electrical Drawings. Clearances shall be provided on each side of the equipment as required for proper maintenance purposes and as required by the Department of Labor and Industry, OHSA and the National Electrical Code.

C. Grades, elevations and locations shown on the drawings are approximately correct; however, the 0.2 Contractor shall field check and otherwise verify grades, elevations, locations, and dimensions at the site before proceeding with the work.

D. The 0.2 Contractor shall make necessary survey equipment available during construction and shall make use of such equipment wherever necessary to properly install his equipment.

1.11 MECHANICAL PLANS

A. The mechanical plans are intended to be diagrammatic and are based on one (1) manufacturer’s equipment.

B. They are not intended to show every item in its exact location, the exact dimensions or the details of the equipment.

C. The 0.2 Contractor shall verify the actual dimensions of any specified or substituted materials and equipment to ensure that they will fit in the available space.

D. The apparatus shall be located as closely as conditions will permit and deviations there from shall be made only with the consent of the Professional and without additional charge.

E. The right is reserved by the Professional to make any reasonable changes in the location of the equipment prior to rough-in without invoking additional expense.

F. The 0.2 Contractor shall be responsible to create and distribute for sign-off amongst other trades ductwork and HVAC piping coordination drawings. Refer to Subsection 3.5 for further clarification.

1.12 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be manufactured in accordance with national standards established by manufacturer's associations, engineering and testing societies, such as NBMA, NEMA, ASTM, AMCA, ASME, ANSI, ACI, etc., where such standards have been established.

B. Equipment shall be furnished by authorized manufacturer’s representatives only. There shall be no exceptions to this requirement.

C. In each case where equipment and materials are specified in the singular or plural number, it is intended that such reference shall apply to as many such items as are required to complete the installation.

D. Equipment and materials of similar types shall be of the same manufacturer unless specifically indicated otherwise on the drawings or herein specified.

E. Materials shall be strictly in accordance with the quality, style, and sizes as specified herein.

F. Manufacturers' names and plate numbers are given in the specifications to denote a standard of quality, style, size, and type and shall exclude material of other manufacturers.

G. The 0.2 Contractor shall make final connections between equipment furnished under this Contract and equipment furnished under other contracts as noted.

H. The materials used throughout shall be those of reputable manufacturers and shall be new and the best of their respective kinds.

I. Equipment, components and materials shall be installed in a neat and workmanlike manner in accordance with best trade practices, manufacturer's recommendations, and applicable codes and standards and by men skilled in each trade of the work assigned to them.

J. The 0.2 Contractor shall properly lubricate the moving parts of equipment and appurtenances installed under this Contract.

1.13 DELIVERY, STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

A. The 0.2 Contractor shall be responsible for the condition of the equipment associated with the work until the date of substantial completion or warranty begins, whichever comes first. Damage to equipment incurred prior to this, based on the sole discretion of the Client Agency, CM, or Professional, shall be the 0.2 Contractor’s responsibility to replace or repair to the satisfaction of said party, at no additional cost to the project. This includes, but is not limited to, damage from transit, site storage, off site storage, mishandling, or misuse during construction.

B. The 0.2 Contractor shall provide products that comply with the contract documents and are undamaged.

C. Damaged products shall not be installed as part of the Work, except at the sole discretion of the Client Agency.

D. The 0.2 Contractor shall bear the costs related to replacing, repairing or refurbishing damaged products.

E. The 0.2 Contractor shall be entirely responsible for the apparatus, equipment and appurtenances furnished by him in connection with the work, and special care shall be taken to protect each component thereof in such manner as may be necessary or as may be directed.

F. Protection shall include covers, crating, sheds, or other means to prevent dirt, grit, plaster, or other foreign substances from entering the working parts of machinery or equipment.

G. Special care shall be taken to keep the open ends of pipes, ductwork, VAV/CAV Boxes and other equipment, etc., closed while in storage and during installation.

H. Where equipment must be stored outside the building, it shall be fully covered and secured with heavy waterproof tarps and kept dry.

I. Where equipment has been subjected to moisture, it shall be suitably dried out before placed in service.

J. Piping, ductwork, materials and equipment shall be stored in areas as designated by the Professional.

1.14 LOCATIONS OF EQUIPMENT

A. The actual runs and locations of the piping, ductwork, equipment, etc., shall be determined at the site and shall be installed to meet the various conditions at the building.

B. It is the 0.2 Contractor's responsibility to predetermine the exact locations of ductwork, piping,

and equipment, and to notify the other contractors accordingly to avoid confliction with other lines and equipment.

C. Any changes necessary to conceal pipes, ductwork or clear pipes and equipment of other trades shall be made without additional expense to the Client Agency.

D. The 0.2 Contractor shall be responsible to create ductwork and HVAC piping coordination drawings and distribute to other contractors for coordination and sign off. Refer to Subsection 3.5 for further clarification.

E. The Professional reserves the right to revise locations of piping, ductwork, locations of equipment, etc., within the building as long as sizes remain the same.

1.15 CONSTRUCTION PENETRATIONS AND OPENINGS

A. The 0.2 Contractor shall furnish and place the sleeves required for pipes or ducts passing through new floors, walls and ceilings before such general construction work is built into place.

B. The 0.2 Contractor shall place the inserts required for hangers and supports, as the construction work progresses, so that unnecessary cutting of construction work will be eliminated.

C. The 0.2 Contractor shall do the cutting and patching required for the installation of his work.

D. Where piping, ducts, or other equipment pass through existing or new fire or smoke barrier stops, walls, floors, or ceilings, the 0.2 Contractor shall furnish and install sleeves and shall thoroughly seal openings around sleeves, pipes, etc. with fire and smoke resistant materials.

E. Materials shall be furnished by the 0.2 Contractor as required to maintain the fire rating of the walls, partitions, ceilings and floors in accordance with the requirements of NFPA, the state building codes and other applicable codes.

1.16 HEATING AND COOLING DURING CONSTRUCTION

A. Advance work as rapidly as possible to permit the heating and cooling systems to be used when it is required for each area of the building.

B. The 0.2 Contractor shall coordinate the operation of the system with the Client Agency so that heat remains on in each area during construction.

C. Provide the required temporary heat as directed by the Client Agency.

1.17 EXCAVATION AND BACKFILL

A. Include any excavation and backfill as required for work included under this Contract.

B. Work shall conform to the applicable state and local regulations governing safety provisions at excavation sites.

1.18 MANUFACTURER’S SERVICE PERSONNEL

A. The 0.2 Contractor shall furnish the services of manufacturers' representatives for the equipment furnished under these Contract Documents.

B. The amount of factory service provided by the 0.2 Contractor shall be as normally recommended and furnished by the various equipment manufacturers unless specified otherwise.

C. Testing of such systems and equipment shall be made under the direct supervision of competent authorized service representatives.

D. In the instance of Mechanical and Control systems, such as the major and special equipment, heating equipment, controls, fans, or similar miscellaneous systems and equipment, the installations, final connections and testing of such systems shall be made under the direct supervision of competent authorized service engineers who shall be employed by the respective equipment manufacturer and/or an authorized representative.

E. The expenses incurred by these equipment manufacturers' representatives shall be borne by the 0.2 Contractor.

1.19 INSPECTIONS AND TESTS

A. Prior to acceptance, the 0.2 Contractor shall notify the Professional, in writing, when the installation is complete and ready for inspections and tests.

B. Inspections and tests shall be conducted in the presence of the Professional to determine compliance with the contract documents.

C. If the installation does not comply with the contract documents, the 0.2 Contractor shall immediately correct each defect and shortcoming.

D. Any additional tests that may be required shall be entirely at the 0.2 Contractor’s expense. Testing shall be completed as directed by the Professional before the system is accepted.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

A. The electrical motors furnished and installed under this Contract shall be manufactured by Reliance, General Electric, U.S. Motors, or approved equivalent and shall be of the proper type and frame of the services involved in accordance with the NEMA and Equipment Manufacturer's recommendations.

B. Motors shall be "energy efficiency" type with 1.15 service factor. Motor windings shall be entirely copper. Where possible, motors shall be permanently lubricated.

C. Where motors must be lubricated, the manufacturer shall furnish the services of a representative to review the lubrication procedure with the 0.2 Contractor and the Client Agency and turn over to both a complete set of the necessary maintenance literature.

D. Motors and installation shall conform to the applicable requirements of the National Electrical Code.

E. Motors shall be suitable for across-the-line or reduced voltage starting as applicable in each instance.

F. Motors shall be inverter rated when controlled by Variable Frequency Drives (VFD’s).

G. Provide the 0.4 Contractor with the motor data to properly size overcurrent protection devices for each combination starter and disconnect switch.

H. The 0.2 Contractor shall be responsible for any additional costs to the 0.4 Contractor resulting from any changes in motor sizes initiated by the 0.2 Contractor, from sizes scheduled on the

Drawings.

2.2 ELECTRICAL BEARING DAMAGE PROTECTION FOR MOTORS WITH VFD'S

A. General Requirements – Shaft Grounding:

1. Motors operated on variable frequency drives shall be equipped with a maintenance free, conductive microfiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge damaging shaft voltages away from the bearings to ground.
2. Application Note: Motors up to 100 HP shall be provided with one shaft grounding ring installed either on the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or the 0.2 Contractor and shall be installed in accordance with the manufacturer's recommendations.

B. General Requirements – High-Frequency Bonding:

1. Motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high frequency ground strap made of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection.
2. Application Note: Proper grounding of motor frame for inverter-driven induction motors

a. References: ABB Technical Guide No.5
b. Allen Bradley Publication 1770-4.1 Application Data, Industrial Automation Wiring and Grounding Guidelines

C. Recommended parts:

1. Bearing Protection Ring
2. High Frequency Ground Strap

D. Acceptable Manufacturers:

1. Electro Static Technology-ITW
Manufacturer of AEGIS® products.
Phone: 207.998.5140
Fax: 207.998.5143
sales@est-aegis.com
www.est-aegis.com

2.3 MANUAL MOTOR STARTERS

A. Manual motor starters shall be furnished by the 0.2 Contractor, for installation by the 0.4 Contractor, for single phase fractional horsepower (1/2 horsepower and smaller) motors.

B. Provide the motor electrical characteristics to the 0.4 Contractor so the 0.4 Contractor may size wiring.

C. The 0.2 Contractor shall coordinate the starter control circuit transformer VA requirements with the ATC Contractor prior to ordering starters.

2.4 MAGNETIC MOTOR STARTERS - FULL VOLTAGE

A. Furnish to the 0.4 Contractor for installation combination full voltage magnetic starters and fused disconnect switches for each 3 phase motor with service factor of 1.15.

B. Starters shall have three (3) current overload relays and low-voltage release.

C. Starters shall be furnished with hand-off-automatic switch, red run light, overload reset, a set of extra auxiliary contacts consisting of one (1) normally open and one (1) normally closed contacts and a control transformer with 120 volt fused secondary control circuit and fused primary circuit.

D. Starter enclosure shall be NEMA 1 enclosures. Furnish Allen-Bradley Bulletin 512 starters or equivalent as manufactured by Square D, General Electric or Siemens.

E. Disconnect switches shall be horsepower rated to match the horsepower of the motors plus 1.15 service factors connected thereto as required.

F. Where starters are separately mounted, they shall be of the magnetic type as herein specified.

G. The magnetic motor starters for motors connected to the normal/emergency electrical distribution system shall be provided with an adjustable time delay unit. Time delay unit shall be capable of delaying motor starting from 0 to 180 seconds.

H. The 0.2 Contractor shall coordinate the starter control circuit transformer VA requirements with the ATC Contractor prior to ordering starters.

2.5 HAND-OFF AUTOMATIC (H.O.A.) SELECTOR SWITCHES

A. The ATC Contractor shall furnish and install remote hand-off-automatic selector switches, where shown or required, and shall be the type that can be changed in the field from two positions and vice versa.

B. Switches shall have padlock attachment that will permit locking in either the manual or automatic positions.

C. Switches shall be furnished with NEMA Type 1 enclosures when installed remote from starter. Provide Cutler-Hammer three (3) position switches, padlocking attachment, or equivalent as manufactured by Square D, General Electric, or Siemens.

D. Starter for the Emergency Generator Supply Fans shall be furnished with an “off-auto” selector switch in lieu of a “hand-off-auto” selector switch as the exhaust and supply fans should operate as a pair of fans.

E. Starters for Stair Tower Pressurization Fans shall be furnished with “key” operable “hand-auto” selector switches in lieu of standard H-O-A selector switches.

2.6 DISCONNECT (SAFETY) SWITCHES

A. Disconnect switches shall be furnished to the 0.4 Contractor for installation.

B. Disconnect switches shall be of the fusible type as indicated, quick-make, quick-break in NEMA Type 1 sheet steel enclosure unless otherwise noted.

C. Disconnect switches shall be horsepower rated, and of size and number of poles as indicated on the Drawings. Safety switches shall be of type having a direct mechanical linkage between contacts and operating handle.

D. Disconnect switches shall be as manufactured by Cutler-Hammer, General Electric, or Square D Company.

E. Fuses for disconnect switches shall be of the UL Class RKI Low Peak as manufactured by the Bussmann Mfg. Division of the McGraw-Edison Company.

F. Fuses for motors shall be sized to conform with the motor running current and in strict accordance with the recommendations of the fuse manufacturer.

G. Where disconnect switches are located at the exterior of the building or in wet locations, they shall be provided with NEMA 3R or 4 weather tight and weather resistant enclosures.

H. Enclosures for disconnect switches located in hazardous areas shall be of the appropriate explosion proof type.

I. Disconnect switches used as service entrance switches shall be Underwriters Laboratories listed suitable for Service Entrance Equipment.

J. Disconnect switches serving remotely mounted soft starters or VFD's shall be furnished with a minimum of one (1) set of normally open auxiliary contacts.

2.7 ACCESS PANELS

A. The 0.2 Contractor shall furnish and install factory-fabricated access panels for access to concealed dampers, damper actuators valves, and other equipment where no other means of access is available. Access panels shall be of appropriate size but not less than 24" flush type, hinged to drop down and out, screwdriver-operated, stainless steel in tile work and prime coated sheet steel in plaster or acoustical tile of every type. The 0.2 Contractor shall furnish and install access panels for the equipment installed under this Contract. Exact locations and sizes of panels shall be determined by the 0.2 Contractor, but panels shall be located for a symmetrical appearance. Access panels are not required at lift-out removable tile ceilings.

B. At locations where access panels are installed in existing or new fire-rated construction, access panels shall contain the 1-1/2 hour fire-rated "B" label; and in addition, shall also be provided with layers of gypsum wall board in a thickness which will supply an additional one and two hour fire rating equal to the fire rating of adjacent construction.

C. Coordinate with the 0.1 Contractor on fire ratings of existing construction.

2.8 FIRE STOPPING

A. The following fire stopping requirements constitute minimum requirements of this specification. The 0.2 Contractor shall be aware of additional requirements by the Client Agency, which may exceed or supersede this specification.

B. Seal openings of fire rated construction with a material or product that has been tested at an independent testing laboratory, such as UL, FM, etc. Fire stopping shall conform to ASTM E-814 and UL 1479, with fire ratings equal to or exceeding the fire rating of the construction involved. Fire stopping shall be UL classified, and shall be like the 3M brand Fire Barrier Penetration Sealing Systems, or approved equivalent. Fire stopping of this type shall also be utilized for openings through smoke rated construction.

C. If desired by the 0.2 Contractor and approved by local codes, the "Pro Set" piping penetration system also may be utilized. Penetration system shall be UL certified and shall be the "Pro Set" System A. Firestop coupling (sleeve) shall be filled with ceramic fiber material to provide insulation and fire stopping. System shall be capable of maintaining a 3-hour fire rating. Penetration system shall be secure, waterproof, fire rated, and smokeproof and shall allow for pipe expansion and contraction.

2.9 EQUIPMENT GUARDS

A. Equipment guards shall be provided for protection at the belts, chains, gears, motors or other moving parts of equipment and machinery installed under this Contract.

B. Guards shall be made up of suitable structural shapes and heavy gauge steel welded together and attached to equipment by removable clips and bolts.

C. Guards shall be neat and substantial and shall be securely attached to equipment.

D. After fabrication, guards shall be cleaned of rust and scale and painted with one coat of metal primer followed by two coats of enamel to match the equipment.

E. Guards shall be easily removable for maintenance and service of equipment.

F. Equipment guards shall conform to OSHA requirements.

2.10 CONCRETE WORK

A. Furnish and install the concrete work related to work included under this contract.

B. Construct concrete forms and bases for the new equipment installed under this contract.

C. Bases and forms shall be of suitable dimensions for the equipment.

D. The concrete work shall be constructed subject to the approval of the Professional.

E. Provide the concrete for repair work related to work included under this Contract.

F. For each piece of floor mounted equipment shown or specified to have a concrete base or pier built on existing floor slab, The 0.2 Contractor shall install a floor slab of suitable size for the equipment to rest thereon.

G. Each foundation shall extend 4" above the floor line (unless otherwise indicated on the drawings).

H. Conform to specific equipment manufacturer's recommendations for construction of bases and foundations in each instance.

2.11 MISCELLANEOUS IRON WORK

A. The 0.2 Contractor shall furnish and install the necessary structural steel members for the proper support of the piping, ductwork, and equipment furnished and installed under this Contract.

B. Miscellaneous iron work shall include, but not be limited to, piping hangers, piping anchors and guides, ductwork supports, and any other equipment supports.

C. Additional structural members shall be furnished and installed to support the heating, ventilating and air conditioning equipment without excessive stress or strain on the building construction.

D. Structural beams and other structural members shall be furnished and installed under this Contract for anchors and guides where the building steel is not available or capable of supporting or anchoring pipelines and equipment.

E. The equipment and materials furnished and installed under this Contract which are not mounted on bases or floors shall be securely attached and supported from the main supporting structure of the building by metal hangers, clamps and/or brackets.

F. Metal hangers, clamps and/or brackets shall be of suitable design and of sufficient strength to properly and safely support the materials and equipment involved.

G. Lag screws and bolts shall be used where required at wood construction.

H. Materials:

1. Structural steel members for the support of equipment installed under this Contract shall conform to ASTM Specifications A-36 and shall comply with the latest requirements of the American Institute of Steel Construction.
2. Structural steel shall be of standard sections as given in the structural steel manufacturers' handbooks.

I. Anchors:

1. The 0.2 Contractor shall provide the anchors, bolts, screws, dowels, and connecting members and perform the cutting and fitting necessary to secure the work to adjoining construction.
2. Build in connecting members to masonry, concrete, and structural steel as the new and remodeling work progresses.

J. Supports and Brackets:

1. Supports and brackets shall be neatly constructed of structural shapes to adequately support the equipment intended.
2. The supports must be approved prior to installation. Field conditions will regulate the type of support.

K. Priming and Painting:

1. Before priming, the metal shall be thoroughly cleaned free from scale, rust, and dirt.
2. The steel and iron work shall be primed with Rust-Oleum X-60, or approved equivalent.
3. Paint final coat black on the miscellaneous steel installed under this contract by the 0.02 Contractor.

PART 3 - EXECUTION

3.1 CLEANING

A. As the work in the building nears completion, threading, cutting, etc., shall be done where directed by the Professional.

B. Upon completion of the work, the remaining waste materials and rubbish resulting from the Contract work shall be removed from the building and premises.

C. At the completion of the work each part of the installation shall be thoroughly cleaned. Strainers, vents, pumps, etc., shall be cleaned of dirt. Temporary replaceable air filters shall be removed, and new replaceable air filters shall be installed after the areas have been cleaned for occupancy. The system shall be operated for a sufficient period to thoroughly remove grease, metal cuttings, and other foreign matter from the system.

D. Any stoppage or any discoloration or other damage to any part of the building, its finish or furnishings due to the 0.2 Contractor's failure to properly clean the piping, shall be repaired by the 0.2 Contractor without cost to the Client Agency.

E. The steam, and condensate piping, boilers and water passages shall be cleaned as indicated in the following sections:

1. 23 2500 Steam Boilers – Convenience Treatment

F. New equipment installed under this Contract, existing remaining equipment, and new and existing furnishings and finishes soiled or damaged due to the work included under this Contract shall be thoroughly cleaned as required to remove plaster, dust, paint splashes, labels and debris.

G. Steam Pipe Additions to Existing Systems:

1. After new steam and condensate return piping is installed, feed the steam line treatment at a high level.
2. Waste the condensate return from the new system to a drain. Do not return to the feed water system. Continue this operation until condensate is clear.
3. Coordinate steam pipe cleaning with the Client Agency and his boiler plant chemical treatment provider.

3.2 INSTRUCTIONS TO OPERATING PERSONNEL

A. The 0.2 Contractor shall satisfactorily complete the systems so that they are functional and operating to the satisfaction of the Professional. The systems, their controls and their sequencing must be demonstrated to the satisfaction of the Professional.

B. Instruct the Operating Personnel as to the proper care and maintenance of the systems installed under this contract.

C. The 0.2 Contractor shall furnish the services of qualified personnel, approved by the Professional and thoroughly familiar with the completed installation to instruct the permanent operating personnel in the proper operation of the systems included under this Contract and the proper care of the equipment and apparatus. These services shall be furnished for a period of five 8-hour days after the operation of the building has been taken over by the Client Agency.

D. When instructions are provided under this Contract, the 0.2 Contractor shall have in his possession three copies of an identifying letter which shall list the names of the 0.2 Contractor's qualified instruction personnel including manufacturers' representatives that will be giving instructions. Likewise, on the same letter, spaces shall be provided for the Client Agency's personnel who will receive the instructions. After instructions have been given and received for each system, The 0.2 Contractor's representatives shall sign and date the letter, and the Client Agency's personnel shall sign and date the letter acknowledging that they have received adequate instructions for operating and maintaining the systems and equipment. A PDF of the signed copy shall be submitted to e-builder as a record of the completed instructions.

E. In addition to the verbal instructions outlined above, the 0.2 Contractor and his manufacturers' representatives shall furnish written basic instructions indicating the proper operation of each system and associated equipment. The 0.2 Contractor shall submit to e-Builder, equipment brochures including instructions on operation, lubrication, recommended spare parts, and instructions on preventative, routine, and breakdown maintenance for equipment by each manufacturer. The brochures and formats must be approved by the Professional.

F. The 0.2 Contractor shall combine the written instructions and the manufacturers' equipment brochures into a PDF of the manuals, indexed by equipment and by manufacturer, which shall be submitted to e-Builder before final acceptance of the Contract work.

G. It is the intent that this entire system with its complement of equipment and auxiliary equipment

operate properly in accordance with the design concept and functional intent. It is also the intent that the Client Agency be given complete instructions for the proper operation and maintenance of the entire system.

3.3 RECORD (AS-BUILT) DRAWINGS

A. The 0.2 Contractor shall maintain a complete PDF set of the Contract Drawings at the site and shall record each deviation in his work **(in red lines and text using mark-up software)** from that indicated on the Contract Drawings. Deviations shall be clearly and accurately recorded so that the Professional can prepare final record (as-built) drawings using the 0.2 Contractor's marked-up PDF's. Dimensions shall be recorded using permanent reference points such as columns, building walls and like items. These record drawings shall be submitted to e-Builder for review and approval by the Professional prior to final acceptance.

3.4 WARRANTY

A. The 0.2 Contractor shall warrant that the materials and workmanship used in the erection of this installation are as herein specified, and he shall provide the necessary labor and materials required to make good any defects in same which become apparent within one year from date of final payment for completed work providing such defects are due to faulty materials or workmanship and not to misuse of apparatus by the Client Agency, his employees, or tenants. Certain equipment shall be warranted or guaranteed for longer than one year from date of final payment where specifically mentioned in these specifications.

B. The equipment and materials manufacturers are expected to recognize that they are responsible for the failure of their products to perform in accordance with data furnished by them or their authorized representatives as well as misrepresentations of such data. When the products have been installed in accordance with the manufacturer's published or written instructions and recommendations and such products fail, then the 0.2 Contractor and the manufacturers are responsible for replacement of the products and the associated work and materials without additional cost to the Client Agency. This warranty applies to each item supplied on the equipment and not just those that are the product of the manufacturer.

3.5 MERCURY PROHIBITION

A. The use of mercury as a component of any equipment installed as part of this work is strictly prohibited. Where required, mercury substitutes shall be used in thermometers, thermostats, switches, and other equipment, which might commonly contain mercury.

END OF SECTION 23 0506

SECTION 23 0511 – RESTORATION AND RETROFIT - HVAC

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 DEFINITIONS

A. The term “The Professional” shall refer to the Professional.

1.4 WORK IN EXISTING FACILITY

A. This work shall be coordinated with the work of other trades and shall be performed in accordance with the Schedule of Work of the as required by the Professional and the Client Agency. The Contractor shall review the phasing schedule and comply with sections of this schedule.

B. The 0.1 Contractor will renovate the existing facility in areas shown on the Drawings in accordance with a specific schedule.

C. The 0.2 Contractor shall refer to the Construction drawings to determine the extent of the renovations in each area.

D. The 0.2 Contractor shall disconnect and remove existing equipment no longer required and furnish and install new equipment as shown, herein specified, and as required to form complete, new systems.

E. Equipment shall include some existing heating equipment, and piping as shown and noted.

F. The Contractor shall visit the site to determine exact locations, sizes and quantities of existing equipment and piping which must be removed.

G. The 0.2 Contractor will be held responsible for the disconnection and removal of existing heating and ventilating systems as noted and the installation of all new piping, ductwork and equipment complete in every detail and in accordance with the phasing schedule.

H. The Contractor shall provide Demolition/Renovation Notification" as required by the State Department of Environmental Resources, Bureau of Air Quality Control.

I. Existing piping and conduit for the heating system no longer required and concealed in walls, pipe tunnels, crawl spaces or above fixed ceilings and not interfering with new construction or renovations may remain and shall be capped, abandoned, and rendered "dead."

J. The Contractor shall arrange the new hangers and supports so that new pipelines and other equipment are not suspended from the same joists and structural members as existing lines and equipment.

K. Hangers and supports shall be arranged to distribute the weight of the new lines and equipment uniformly on the existing structure.

L. Additional new structural members shall be furnished and installed as necessary to safely support the new lines and equipment.

M. The Contractor shall clean the work areas as the work progresses and thoroughly remove waste and debris daily or when directed.

N. The Contractor shall perform the cutting and patching required for the installation of new piping, and equipment, and for the removal of existing equipment as herein specified.

O. The 0.2 Contractor shall be responsible for maintaining the structural integrity of the existing facility where areas such as load bearing walls, and floor construction are patched and repaired under this Contract.

P. The patching shall be done subject to the approval of the Professional.

Q. The 0.2 Contractor will be responsible for entrance of the new equipment into the facility, for the removal of existing equipment from the facility, and for the associated cutting, patching, and repairing of existing construction.

R. Useful Existing Equipment to Be Removed:

1. Existing removed unit heaters, fans and other similar useful equipment and materials, tagged by the Client Agency, shall remain the property of the Client Agency and shall be stored at the site as directed by the Client Agency and Professional.
2. Equipment shall be stored as complete units with the associated accessories and auxiliary equipment.
3. Equipment shall be disconnected and carefully removed under this Contract and shall be transported to the storage areas as directed.
4. Equipment shall be stored in a neat and workmanlike manner, tagged, and identified for future use.

S. Removed piping, fittings, hangers, and other miscellaneous materials and equipment no longer required, shall not be reused as a part of the new installation, but shall become the property of the Contractor and shall be immediately removed from the site. The 0.2 Contractor shall give due consideration and credit in his proposal for existing materials and equipment which will become his property. Existing removed equipment remaining the property of the Contractor shall be dismantled and cut in sections as required for removal from facility.

T. The Contractor shall provide and later remove temporary HVAC services and equipment as required to keep systems operating during construction. The Contractor shall maintain acceptable temperatures in construction-impacted spaces where Client Agency operations, functions and services continue to be provided.

1.5 REMOVAL AND DISPOSAL OF HEALTH HAZARDOUS MATERIALS

A. Asbestos removal work shall be performed by a contractor prior to the start of this construction.

B. This Contractor shall immediately report the presence of any asbestos to the Professional. No asbestos removal is to be included under this Contract.

1.6 CUTTING AND PATCHING

A. The Contractor shall perform the cutting and patching for the removal of existing piping, ductwork

and equipment and the installation of new piping, and equipment in the existing facility.

B. New openings in walls, floors, and partitions for pipelines, hangers, supports, and other equipment in the existing facility shall be provided by this Contractor for the new and renovated installation.

C. New openings in existing construction and the repair of such openings for the entrance of new heating, ventilating and air conditioning equipment into the facility or for the removal of existing heating and ventilating equipment from the facility shall be included in the HVAC Contract.

D. Openings in existing exterior walls shall be cut by the 0.2 Contractor.

E. Openings in existing roofs shall be the responsibility of this Contractor. Final roofing shall be done by the Roofing Contractor as called out in the Professional's Front End Specifications.

F. When necessary to cut out any portions of walls, floors, ceilings, or other portions of the facility, as required to perform the work under this Contract, the Contractor shall perform the necessary cutting and fitting, shall remove the excess material, and shall replace damaged work to leave the premises in a finished condition.

G. No cutting shall be done which may in any way affect the facility structurally or architecturally without first securing the consent and approval of the Professional.

H. Any damage incident to cutting or other causes in the performance of this Contract shall be made good by replacement or repairs in a manner satisfactory to the Professional.

I. The Contractor shall not disturb or weaken the bearing quality of existing walls or other construction.

J. Where existing equipment is removed and unused openings remain in walls, floors, partitions, etc., the 0.2 Contractor shall properly patch such openings to match their immediate.

K. Cutting performed under this Contract shall be done in a neat and workmanlike manner. The size of each new opening shall be kept to minimum size. The location of each new opening must be approved by the Professional before the opening is drilled or cut.

L. Where existing ceilings and walls and similar construction are penetrated for the installation of new hangers, supports, and other equipment, the Contractor shall repair the openings with fireproof materials to maintain the fire rating of the ceiling or wall construction, or similar construction.

M. The Contractor's attention is directed to the Architectural Drawings to determine areas in which the other contractors will perform work. Cutting and patching shall be directly coordinated with work performed by other contractors. This Contractor shall cooperate with the other contractors in every manner in making the installations.

N. Patching and Repairing:

1 Patching and repairing shall be by workmen skilled in this type of work and shall match existing or new finishes.
2 Patching and repairing shall match existing construction and finishes in materials, color, and texture.
3 Cutting, patching, repairing, and painting shall be performed by workmen skilled in that type of work.
4 Patching shall be completed to a neat, finished condition.
5 Where the existing area is to be repainted by the Painting Contractor, the 0.2 Contractor

must repair his openings and provide a prime coat and one finish coat of paint to be ready for the Painting Contractor's final coat of paint.

6 The Contractor's attention is directed to the Professional's Construction Drawings to determine exact locations where new finishes on walls, floors, ceilings, and similar locations will be provided under separate Contract.

7 The 0.2 Contractor shall repair and finish all openings where the other Contractors are not providing new finishes.

8 When providing final painting of patched areas, the entire wall or ceiling shall be painted corner to corner and top to bottom so that the entire wall or ceiling is painted.

9 Painting of existing walls or ceilings will not be necessary unless the walls or ceilings are patched and repaired under this Contract.

1.7 DUST, DIRT, AND NOISE

A. The Contractor shall perform cutting and patching and shall make modifications, relocations, and installations with a minimum of noise.

B. Existing and new equipment, floors, walls, etc., shall be adequately protected from dust and dirt caused by the work.

C. Protection shall include suitable temporary barriers or coverings.

D. The exterior and interior premises of the facility shall be kept as clean as possible during construction.

E. At no time shall the Contractor interfere with the normal operation of the facility by allowing debris, etc., to remain on the premises.

F. Contractor shall use industrial type vacuum cleaners for removal of plaster, dust, etc. in each area of the facility included in his scope of work.

1.8 SCHEDULE OF WORK AND CONTINUITY OF SERVICE

A. It is the Client Agency's desire to maintain the operation of the existing facility with a minimum of disruption; therefore, the Contractor shall closely coordinate the scheduling of his work as well as equipment deliveries with the Schedule of Work prepared by the Professional.

B. The schedule of work may be revised periodically during construction, but each revised schedule must be approved by the Professional.

C. When it becomes necessary to interrupt any part of the operation of the HVAC system, the Contractor shall notify the Professional and Client Agency a minimum of 72 hours in advance of the proposed interruption. Any interruption of operation of the HVAC system is required to be coordinated with the Client Agency.

D. The HVAC system shall only be interrupted when necessary and at a time to conform to the Client Agency's schedule.

E. Long interruptions of the HVAC system, due to faulty workmanship or improper scheduling of work will not be tolerated. The facility must remain in use.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE

PART 3 – EXECUTION

3.1 NOT APPLICABLE

END OF SECTION 23 0511

SECTION 23 0519 – PIPING SPECIALTIES – HVAC

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SCOPE

A. The piping specialties for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.1 GAUGES AND THERMOMETERS

A. Furnish and install all pressure gauges and thermometers as herein specified. All pressure gauges shall be calibrated at the site by the Contractor at the same point of connection. Separable wells shall be installed by the Heating Contractor at each location.

B. Pressure gauges shall be 4½" diameter and adjustable to zero to compensate for static water pressure. Gauge dial ranges on the water systems shall be graduated 0 to 100 psi with 10 psi figure intervals and 1 psi graduation, for the water system. Accuracy of each gauge shall be ½ of 1% over entire scale range. Cases shall be cast aluminum with black finish and chrome ring. Pressure gauges shall be of the bronze bourdon tube type with 4½" diameter dials similar to the 500X Series, each with No. 872-2 pressure snubber, and No. 735-2 needle valve as manufactured by Trerice, Ashcroft, Weksler, Miljoco or equal as approved by the professional.

C. Thermometers shall have 9" scales, adjustable angle non-mercury thermometer with "A" Series brass stem. Range for hot water lines and equipment shall be 30 degrees F. to 300 degrees F. Thermometers shall each have a stainless steel front with glass cover and shall be provided with a suitable stainless steel separable socket. Thermometers shall be the BX Series, adjustable angle type, as manufactured by Trerice, Ashcroft, Miljoco or equal as approved by the professional.

D. Stem lengths shall range between 30% and 50% of inside diameter of piping, and wells shall be arranged to accommodate stems.

E. Thermometers and gauges shall be installed in a manner that will allow them to be easily read from the operating floor.

F. In lieu of installing a multiple number of pressure gauges at circulating pumps, the Contractor shall have the option of installing one pressure gauge of type herein specified mounted on a multiple port manifold valve constructed of brass and suitable for 175 PSIG working pressure. Manifold valve shall be furnished with spring return pushbutton ports with 1/4"

O.D. compression unions, mounting bracket and capped test port connection for gauge calibration. Furnish and install Type L 1/4" O.D. copper tubing with flared connections from manifold valve ports to locations on pump casing and piping where pressure gauges would normally be installed, generally where indicated on the Drawings. Furnish and install screwed connectors, compression union and shut-off valve at each connection to piping or pump casing. Copper tubing shall be installed in a neat workmanlike manner and shall be properly supported. Manifold valves shall be mounted on system piping at convenient location to permit easy access for pushbutton operation and pressure gauge observation.

2.2 PRESSURE TAPS

A. At locations shown on the Drawings, the Contractor shall furnish and install combination pressure and temperature taps on supply and return lines at all terminal equipment and at other locations indicated on the Drawings. Pressure and temperature taps at each location shall consist of a 1/4" NPT fitting to receive either a temperature or a pressure probe 1/8" O.D. The fitting shall be solid brass with two (2) self-closing valve core of Nordel suitable for a temperature of 275 degrees F. and pressure rating of 1,000 PSIG, fitted with a yellow color-coded and marked cap with gasket. Fitting shall be the "Pete's Plug" Model 110XL, as manufactured by the Peterson Equipment Co., Inc. or equal as approved by the professional. Fitting shall be capable of passing a no-leakage test by a recognized testing laboratory for a minimum of 80 insertions during a five day period at a pressure of 100 PSIG and temperature of 240 degrees F.

B. Furnish and deliver to the Client Agecny, a separate Test Kit consisting of a 0-200 PSI, 0-230 foot of water pressure gauge with a 1/8 inch O.D. gauge adapter attached, a 0 degree F. to 220 degrees F. pocket testing thermometer, and a protective carrying case. The Contractor shall also supply the Client Agency with two additional pressure gauge adapters (Model 500XL) with 1/8" O.D. probe and four five inch stem pocket testing thermometers graduated 0 degrees to 220 degrees F.

2.3 ELECTROLYSIS CONTROL

A. All copper tubing installed or connected under this Contract shall be installed in such a manner that the tubing will not touch or come in contact in any way with ferrous metals. Where copper tubing, piping or fittings are anchored, guided, supported or may come in contact with ferrous metal construction, an insulating nonconductor spacer, similar to rubber or fiber, shall be installed to assure prevention of electrolysis.

B. Copper tubing lines shall not be (even temporarily) supported or secured to ferrous metals. When copper tubing or piping is connected to ferrous piping or equipment, connections shall be made with dielectric unions, couplings or fittings, as manufactured by Epco Sales, Inc., Walter Vallett Company, Watts Regulator Co., Clear-Flow, or equal as approved by the professional.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install all equipment per manufacturers recommendation and Best Industry Standards.

END OF SECTION 23 0519

SECTION 23 0523 – HVAC VALVES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SCOPE

A. The valves for the various HVAC systems shall be as hereinafter described in this section.

1.4 SUBMITTALS

A. Provide data sheets for each valve type and accessory to be included on this project.

B. Submitted valves and accessories shall conform to the specifications, including materials, sizes and styles.

PART 2 - PRODUCTS

2.1 VALVES AND ACCESSORIES – CIRCULATING WATER SERVICE

A. Circulating Water Service shall include the following:

1. Domestic Cold Water Make-Up
2. Associated drain, relief and vent piping

B. General Requirements:

1. Furnish and install valves and piping system accessories indicated on the Drawings or as required for proper operation of the systems.
2. Unless otherwise specified, valve numbers in the Specifications are taken from the catalog of NIBCO Inc., and are intended to denote a standard of quality and type required. Comparable valves of other manufacturers, such as Milwaukee, Hammond, Apollo, Crane, Jamesbury, Neles, Victaulic or equal as approved by the professional will be acceptable.
3. Valves shall be of one manufacturer, except where specified otherwise.
4. **Apollo International is <u>not</u> acceptable.**
5. In general, ball valves and butterfly valves shall be used on water lines where the service requires valves to be wide open or tightly closed.
6. Plug valves shall be used where services require valves to be throttled.
7. Valves in Mechanical Equipment Rooms shall be provided with <u>chain operators</u> to make valves accessible from the floor where valves are located out-of-reach of operating personnel, 7’-0” feet in height or higher.
8. Valves, except where specified otherwise, shall be suitable for at least 200 PSI minimum water working pressure, Class 125. Valves, except on small threaded or soldered lines, shall be flanged.

9. Bronze valves, including bronze check valves, shall be made to be “dezincification resistant”, with metal components in the waterway not containing more than 15% zinc in their chemical makeup.

C. Gate Valves:

1. Gate valves 2" and smaller shall be bronze body, bronze-mounted, threaded pattern, solid wedge, inside screw, rising stem; solder pattern for copper lines.
2. Valves 2½” and larger shall be iron body, bronze-mounted, flanged, OS&Y pattern.
3. Iron body valves shall be suitable for 125 PSI SWP, Figure No. F-617-0.
4. Bronze body valves shall be suitable for a minimum of 125 PSI SWP, Figure No. T-111.
5. Valves on copper tubing water lines shall be suitable for a minimum of 125 PSI SWP and shall be solder end type, Figure No. S-111.

D. Ball Valves:

1. Ball valves shall be installed on all water service lines 2" and smaller and shall be two-piece bronze body, stainless steel stem and ball, with a conventional port, reinforced TFE packing (no "O" ring), with insulated operator, 600 PSIG CWP.
2. Ball valves shall be suitable for -40°F. to 350°F.

E. Butterfly Valves:

1. Butterfly valves shall be BOS-US, uninterrupted seat, offset disc, resilient seated, as manufactured by DeZurik, 815 Series as manufactured by Jamesbury, Vic®-300 MasterSeal™ series as manufactured by Victaulic, or approved by professional.
2. Butterfly valves shall be furnished and installed on water lines 2-1/2" and larger. Valves shall be guaranteed for zero-leakage bi-directional shut-off, complete with manual infinite throttling handle and position indicator, and suitable for dead-end service.
3. Valves shall be suitable for 200 PSI CWP, shall be complete with EPDM seat and shaft seals suitable for high temperature (250°F.) service, aluminum bronze bearings, 316 SS discs, lug type ductile iron body, and 316 SS stem.
4. Bodies shall be furnished with tapped lugs and flange bolts or grooved fittings to allow downstream piping to be disconnected, leaving the valve in line to control the flow.
5. Bolts shall be installed at each side of the lugs to allow downstream piping to be disconnected.
6. Butterfly valves 4" and smaller shall be furnished with a hand lever operator.
7. Butterfly valves 6" and larger shall be furnished with a quarter turn gear operator with hand wheel.
8. Valves shall be furnished with a disc position/over-travel indicator to provide visual indication of disc position and to simplify actuator adjustment.

F. Globe Valves:

1. Globe valves 2" and smaller shall be bronze body, bronze-mounted, threaded pattern, solid wedge, inside screw, rising stem; solder pattern for copper lines.
2. Valves 2½” and larger shall be iron body, bronze-mounted, flanged, OS&Y pattern.
3. Iron body valves shall be suitable for 125 PSI SWP, Figure No. Figure No. F-718-B.
4. Bronze body valves shall be suitable for a minimum of 125 PSI SWP, Figure No. Figure No. T-211 or angle valve T-311-Y.
5. Valves on copper tubing water lines shall be suitable for a minimum of 125 PSI SWP and shall be solder end type, Figure No. Figure No. S-211 or angle valve S-311-Y.

G. Plug Valves:

1. Plug valves at locations on water mains, isolation valve stations, pumps, and on water

piping 2½" and larger at terminal equipment, shall be the gland-packed type, complete with resilient facing, suitable to 250°F., similar to DeZurik Series 100, Keystone "Ballcentric", or approved by professional.

2. Plug valves 2" and smaller shall be DeZurik Figure 120, Keystone "Ballcentric", or approved by professional, suitable for 175 PSI WWP and shall be provided with bronze bodies, screwed ends, stainless steel bearings, and resilient plugs.
3. Plug valves 2½" and larger shall be DeZurik Figure 118, Keystone "Ballcentric", or approved by manufacturer suitable for 175 PSI WWP and shall be provided with cast iron bodies, nickel seats, flanged ends, and resilient plugs.

H. Manual Balancing Valves:

1. Furnish and install one manual balancing valve at each water terminal equipment coil on 2" and smaller return piping.
2. Valves shall be suitable for combined indicating, balancing, and tight shut-off. Valves shall be the Circuit Setter Plus by Bell and Gossett, Quick Set by Griswold Controls, the UltraXB Orturi Model XB by Nexus, Model TBV by IMI, ACCU FLO by Taco, TA Series 786/787/788/789 and 78K by Victaulic / Tour Anderson, or NIBCO styles 1810, F737A, and G737.
3. Valves shall be suitable for 300 PSI water pressure, 250°F. total temperature, and shall have full turn balancing device, lockable in any position.
4. Valves shall be equipped with a visible indicating dial with screwdriver adjustment.
5. Valves shall be re-packable under pressure.
6. Balancing valves 4" and smaller shall be furnished with a hand lever operator.
7. Balancing valves 6" and larger shall be furnished with a quarter turn gear operator with hand wheel.
8. Balancing valves shall be furnished with a disc position/ over-travel indicator to provide visual indication of disc position and to simplify actuator adjustment.

I. Check Valves (Pump Discharge, Surge, & Water Hammer):

1. Check valves at pumps and on water piping 2½" and larger shall be of type that controls surge pressures and resulting water hammer.
2. Valves shall be iron body, flanged, with bronze trim.
3. Check valves shall be "Silent Check Valves", the Nibco No. F-910-B-LF, Metraflex Company, Techno Corp., or approved by professional.

J. Check Valves:

1. Check Valves 2" and smaller shall be bronze body, horizontal swing, regrinding type, Y-pattern, renewable seat and disc, threaded ends, or solder ends for copper lines.
2. Bronze body valves shall be suitable for a minimum of 125 PSI SWP.
3. Valves on copper tubing water lines shall be suitable for a minimum of 125 PSI SWP.

K. Strainers:

1. Furnish and install Y-type strainers. Baskets in strainers shall be stainless steel, 2" and smaller shall be No. 20 mesh, and 2½" and larger shall have 1/8" diameter perforations.
2. Each strainer shall have a full size gate valve on the blowdown drain connection with drain line extended to funnel
3. Valves, nipples and strainer baskets shall be readily removable.
4. Strainers 2" and smaller shall be bronze body, screwed or sweat ends as required, Spirax Sarco Type BT or TBT, Armstrong, Watts, or approved by professional.
5. Strainers 2½" and larger shall be cast iron body, flanged, Spirax Sarco Type CI-125 or F-125, Armstrong Type A1FL-125, Watts, or approved equivalent.

L. Safety Relief Valves:

1. Safety relief valves shall be installed on water piping as required by local regulatory agencies having jurisdiction.
2. Safety relief valves shall serve the dual purpose of relieving over-pressure created by thermal expansion and over-pressure in the form of water.
3. Safety relief valves shall be ASME rated and shall be similar to Watts Series 174A and 740, Kunkle, Conbraco, or approved equivalent.
4. Discharge of safety relief valves shall be piped to funnel drains or floor drains.
5. Safety relief valves shall be ASME approved and certified by the National Board of Boiler and Pressure Vessel Inspectors and shall bear approval stamps, along with pressure and capacity data.

M. Manual Air Vents:

1. On each high point of water mains and on coils and other heating terminals furnish and install a ¼" manual air vent with full sized gate valve. Air vent outlets shall be extended to accessible locations. Air vent outlets shall terminate over funnel or floor drains where possible. Where necessary, hose end adapters shall be provided on vent piping.
2. Furnish and install on high point of each coil in each cabinet unit heater, and radiant panel, one manual air vent similar to Dole No. 14, or approved by professional. Vents shall be connected to coil vent taps and extended to an accessible location in each cabinet. Vent tubing shall be coiled and outlet extended to a point near access door. Tubing within the cabinets shall be securely anchored.

N. Automatic Air Vents:

1. Furnish and install on each horizontal delivery propeller type hot water unit heater, one automatic float type air vent, similar to Hoffman No. 79, or approved equivalent. Provide cock at each vent. Vents shall be suitable for 75 PSIG operating pressure.
2. Automatic air vents on lines at locations shown shall be the Armstrong No. 1-AV with petcock, Spirax Sarco No. 13WS, Apco No. 50, or approved by professional. Air vents shall have 150 PSI cast bodies and stainless steel trim.

O. Drain Valves:

1. Low points of the piping system shall be provided with drain valves so that the complete system can be drained.
2. Each down fed unit or other equipment shall be provided with drain valves.
3. Drain valves shall be ½" with hose end and cap.

P. Unions:

1. Unions shall be 300 lb. WOG, malleable iron ground joint type, with bronze-to-iron seat, Class 150, Grinnell Fig. No. 463, or approved equivalent.

Q. Grooved End Valves:

1. Butterfly Valves:

    a. Grooved end butterfly valves shall be furnished and installed on water lines 2" and larger utilizing a grooved piping system.
    b. Valves shall be suitable for bi-directional, dead-end, and bubble-tight shut off at full rated pressure.
    c. Grooved end butterfly valves shall be as manufactured by Victaulic or equal as approved by the professional as follows:

d. 2” through 12”: Ductile iron body, electroless nickel or polyamide coated, ductile iron disc, blowout-proof 416 stainless steel stem. Disc shall be offset from the stem centerline to provide full 360 °° seating. EPDM pressure responsive seat and seal material, TFE lined fiberglass bearings, lever handle or gear operator with handwheel and memory stop feature, 300 PSI, grooved ends designed for installation with Victaulic standard couplings. Victaulic Vic®-300 MasterSeal™, NIBCO GD-4765 Series, or approved by professional.
e. 14” through 24”: Polyphenylene Sulfide (PPS) coated ductile iron body and disc, 17-4 PH stainless steel stem design, EPDM seal, reinforced PTFE bearings, gear operator with handwheel and memory stop feature, 300 PSI, AGS grooved ends designed for installation with Victaulic “W” series couplings. Disc shall be offset from the stem centerline to provide full 360 degree seating. Victaulic Vic®-300 AGS or approved by professional.
f. Butterfly Valves on copper tubing water lines 2½” Inch through 6 Inch shall be grooved end type, Victaulic Butterfly Series 608N, or approved by professional.

2. Check Valves:

a. Check valves at pumps and on water piping 2” and larger utilizing a grooved piping system shall be spring-assisted, “Silent Check Valves” as follows:
b. 2” through 3”: Ductile iron body, stainless steel disc and spring, brass shaft, nickel-plated seat and grooved ends, 365 PSIG CWP.
c. 4” through 12”: Ductile iron body, elastomer encapsulated ductile iron disc, stainless steel spring and shaft, welded-in nickel seat, grooved ends, 300 PSIG CWP.
d. 14” through 24”: Ductile iron body, 304 stainless steel dual disc design, stainless steel spring and shaft, EPDM seat bonded to the valve body, AGS grooved ends, 230 PSIG CWP.

3. Strainers:

a. Furnish and install grooved end strainers on water systems 2-1/2” and larger utilizing a grooved piping system.
b. Y-Type, 2” through 18”: Ductile iron body, Type 304 stainless steel perforated metal removable baskets with [0.062”] [0.125”] [0.156”] diameter perforations, blow down port with off-centered pipe plug, 300 PSIG CWP. Victaulic Series 732 and W732.
c. T-Type, 2” through 12”: Ductile iron body, Type 304 stainless steel mesh removable basket, no. 12 or no. 6 mesh, 57% free open area, removable access coupling and cap for strainer maintenance. Victaulic Series 730.
d. T-Type, 14” through 24”: Carbon steel body, Type 304 stainless steel mesh removable basket, no. 6 or no. 4 mesh, 57% free open area, carbon steel t-bolt hinged closure/cap for strainer maintenance, AGS grooved ends. Victaulic Series W730.

2.2 GAS SERVICE VALVES

A. Valves on gas lines 2" and smaller shall be the NIBCO No. T-580-70-UL or T-585-70-UL, or approved equivalent.

B. Valve shall be suitable for natural gas use, UL listed, bronze body, bronze ball, threaded ends, and with blowout-proof stem.

C. Valve shall be rated at 600 PSIG WOG.

D. Valves on gas lines 2-1/2" and larger shall be the lubricated plug type, gray iron construction, flanged pattern, and shall be the Rockwell-Nordstrom No. 115, or approved equivalent.

E. Furnish suitable valve wrenches

2.3 PRESSURE REDUCING VALVES (for Domestic Cold Water Make-Up):

A. Furnish and install on domestic cold water makeup piping to the circulating water system, and/or steam system, water pressure reducing valves like the Watts Model U5B or approved by professional, as required to provide automatic filling of the systems.

B. Pressure reducing valves shall each be suitable for 200 PSI WWP, with cast bronze body and bronze trim, sizes shown on the Drawings, but not less than 3/4" size.

C. Pressure reducing valves shall be set at pressure indicated on the Drawings.

2.4 DOUBLE CHECK VALVE ASSEMBLIES (for Domestic Cold Water Make-Up):

A. Double check valve assemblies on domestic cold water make-up piping shall be approved by professional.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install valves as described above and per manufacturer recommendations.

B. Grooved Joints:

1. Grooved joints shall be installed in accordance with the manufacturer’s latest published installation instructions.
2. Grooved ends shall be clean and free from indentations, projections, and roll marks.
3. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service.
4. A factory-trained field representative (direct employee) of the mechanical joint manufacture shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products.
5. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed.
6. A distributor’s representative is not considered qualified to conduct the training.
7. Contractor shall remove and replace any improperly installed products.

END OF SECTION 23 0523

SECTION 23 0529 – PIPE HANGERS AND SUPPORTS - HVAC

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SCOPE

A. The hangers and supports for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.1 GENERAL

A. All piping shall be supported from the building construction by the use of fixed or adjustable beam clamps, concrete inserts, welded structural attachments, lag bolts and lag screws from wood construction, brackets, extension rods, adjustable band ring pipe hangers, or other equipment as dictated by the type of building construction.

B. Furnish and install all structural steel members for the support of the piping, and equipment to suit the structural and vibration isolation conditions.

C. Hangers and supports shall be arranged to distribute the weight of the piping and equipment uniformly on the Building structure.

D. All necessary structural supports and inserts to hang all piping and equipment shall be provided by this Contractor. Hanger rods shall be securely attached to plates. Where cutting is required for the installation of hangers, piping and supports, all openings must be neatly drilled by the Heating Contractor. Punching or chipping of concrete will not be permitted. All necessary openings shall be drilled in a location and manner satisfactory to the Professional. All concrete damaged by the Heating Contractor shall be patched, reinforced or replaced as directed by the Professional. Location of all holes, openings and sleeves shall clear reinforcing steel in floor and roof decks. The Heating Contractor shall coordinate all work with the Professional and shall determine exact locations of all supports, especially for those for vibration isolation, and openings,

E. Insulation shall be installed over band hangers and all openings shall be sealed as hereinafter specified.

F. Piping shall only be supported by code approved and manufacturer recommended hanger systems connected directly to the building’s structure.

G. The Contractor shall support piping mains as required in accordance with these specifications.

H. Pipe hangers and supports must comply with ANSI/MSS-SP-58-2018.

2.2 HANGERS FOR STEEL PIPE

A. Hangers for all steel piping shall be complete with band hangers, turnbuckles, and rods. Hanger bands shall be flat and suitable for application of insulation over the hanger and pipe.

B. Acceptable Manufacturers:

1. Basic-PSA, Model BE 124, BE124-1, BE 124-2, BE 124A-1, & BE 124A-2
2. Modern Pipe Supports Corp., Figure 87
3. Anvil International, Figure 295
4. Equal as approved by the professional.

2.3 HANGERS FOR COPPER PIPE

A. Hangers for all copper piping shall be complete with all-copper band hangers, turnbuckles, and rods. Hanger bands shall be flat and suitable for application of insulation over the hanger and pipe.

B. Acceptable Manufacturers:

1. Modern Pipe Supports, Corp, Figures 48, 49, 59, and 403
2. Equal as approved by the professional.

C. Copper piping shall be supported with flat band copper hangers as hereinafter specified.

D. All supports directly in contact with copper lines shall be all copper where possible or copper-plated where approved by the Professional. Ferrous metals shall not be used in contact with copper lines. Hangers shall be all-copper as hereinbefore specified.

E. PVC coated steel hangers are acceptable on the condition that the coating is undamaged and without penetrations to the underlying steel.

F. In lieu of copper band hangers, the Contractor will be permitted to use a steel clevis type hanger with the pipe insulation acting as an isolator to prevent electrolysis between the pipe and hanger. Clevis hanger shall be complete with hanger, adjuster, rod and insulation protection saddle

1. Acceptable Manufacturers:

a. Modern Pipe Supports Corp., Figure 590
b. Basic-PSA, Model BE 120
c. Anvil International, Figure 260
d. Equal as approved by the professional

G. Clevis hangers are acceptable only as hereinbefore specified for copper tubing.

2.4 HANGER RODS

A. Hanger rods installed in conjunction with hangers shall be not less than the following:

Pipe Size	Hanger Rod Diameter
1/2" to 2"	3/8"

Pipe Size	Hanger Rod Diameter
2-1/2" and 3"	1/2"
4" and 5"	5/8"
6"	3/4"
8" to 12"	7/8"

B. Hanger rods shall be larger where recommended by the hanger manufacturer.

2.5 PIPE SUPPORT SPACING

A. Pipe supports shall be spaced as indicated below. Smaller pipe shall be provided with additional supports to prevent lines from sagging.

MAXIMUM PVC AND COPPER PIPE SUPPORT SPACING

Pipe Size	PVC, FT	Copper, FT
Up to 1-1/2”	3	6
2” and Larger	4	8

MAXIMUM STEEL PIPE SUPPORT SPACING

Pipe Size	Water Service, FT	Steam, Air & Gas Service, FT
1”	7	9
1-1/2”	9	12
2” & 2-1/2”	10	13
3”	12	15
4” & 5”	14	17
6”	17	21
8”	19	24
10”	22	28
12”	23	30

B. Where concentrated loads occur, closer spacing may be necessary.

C. The Contractor shall minimize the sagging of pipe. Where piping is intended to slope (i.e. drains and condensate return lines), the Contractor shall maintain the slope of the piping to minimize pockets of standing water.

D. Hangers must be installed not more than 2.5 pipe diameters from each change in horizontal direction of pipes.

2.6 SUPPORT OF VERTICAL PIPES

A. All vertical runs of piping shall be supported at each floor and/or at specified intervals, by means of riser clamps or pipe lugs.

B. Riser clamps with bolts and hex nuts shall be used for support of vertical lines in pipe spaces and other locations required.

C. For vertical pipe runs, risers shall be suspended from or supported by steel spring isolators (Mason Industries type PC3ON hangers, type SLR mounts, or equal) and the piping restrained or guided by all-directional supports (Mason Industries type ADA, or equal). Steel spring deflections shall be 3/4", except in those expansion locations where additional deflection is required to limit deflection or load changes to +/- 25% of the initial stress.

D. All vertical runs of piping shall be supported at each floor and/or at specified intervals, by means of riser clamps. Copper tubing shall be protected against electrolysis, such as PVC coating or plating, or by the use of an all-copper clamp. Riser clamps placed on floor construction in finished areas, including stairwells, will not be permitted.

E. Copper tubing shall be protected against electrolysis, using PVC coating or plating, or by the use of an all-copper clamp.

2.7 SLEEVES

A. Where vertical pipes pass through floors in mechanical equipment areas, chases or pipe spaces, the Contractor shall construct watertight sleeves made up of a section of Schedule 40 steel pipe extending 4" above the floor.

B. Where vertical pipes pass through floors in finished spaces, the Contractor shall construct watertight sleeves made up of a section of steel pipe of proper length to extend through masonry and terminate flush on finish side.

C. Where horizontal pipes pass through walls, sleeves shall be as specified above terminating flush with finish on each side.

D. Where vertical pipes pass through plaster or dry wall ceilings, sleeves shall be No. 18 gauge galvanized steel flush with ceiling.

E. Where piping is insulated, insulation shall be extended through sleeves. Sleeves shall be at least two sizes larger than the pipe or of suitable dimensions to allow the installation of pipe, insulation and sealant.

F. At all locations space between sleeve and pipe shall be filled with sealant to level of sleeve. Sealant shall be Dow Corning 3-6548RTV, or approved equal. Conform to manufacturer's recommended installation procedures.

G. Sleeves and inserts shall be installed in concrete. Sleeves shall be large enough to receive the insulation and jackets.

2.8 INSERTS

A. The Contractor shall place all hanger and support inserts in concrete. Special studs "shot" into concrete will not be permitted.

B. All expansion shells shall be of the self-drilling types as manufactured by the Phillips Drill Company, Ramset, Rawlplug, or equal as approved by the professional. Shells shall be the hammer installed, special flush or hanger rod types. Shells shall be installed with a drill-hammer.

C. Lead expansion shields or lead wedge type shields are not permitted.

D. Epoxy adhesive anchors, Hilti or equal, shall be used where specified on the design drawings.

2.9 ATTACHMENTS

A. Beam clamps are permitted on 2-inch pipes with a service temperature of 180°F or less and shall be fixed or adjustable as manufactured by Modern Hangers, Penn Pipe Hanger Co., Arrow Pipe Hanger Co., or equal as approved by the professional.

2.10 PENETRATIONS

A. Seal all openings through walls of air plenum spaces and relief air shafts, where ducts, pipelines, etc. are installed under this Contract to assure airtight plenum spaces. Coordinate all work with contractors of other trades.

B. Where pipes of any type pass through new fire and smoke barrier stops, ceilings, floors or walls, this Contractor shall thoroughly seal such openings with fire-rated sealant as required to maintain fire-rating of adjacent construction.

C. Where exposed pipes pass through walls, floors or ceilings of finished rooms, furnish and install steel chromium-plated setscrew type floor, wall or ceiling plates.

2.11 PIPES SUPPORTED FROM STEEL JOISTS

A. The weight of pipe supported from steel joists shall be distributed as follows:

Pipe Size	Minimum Requirement
2” and Smaller	Pipe shall be hung from one joist with beam clamps
2” to 3”	Pipe shall be suspended from 1-1/4" steel pipe or steel angle, laid-in and hook-bolted to the web members of the joists.
4" and 5"	Pipe shall be supported from three joists.
6" and over	Pipe shall be supported from not less than four joists

2.12 SUPPORT OF PIPES ALONG WALLS

A. Lines along walls shall be supported on neat, substantial wall hangers securely attached to construction by means of inserts or expansion sleeves, or adhesive anchors, and bolts.

B. Acceptable Manufacturers:

1. Basic-PSA, Model BE 203, BE 204, and BE 205
2. Modern Pipe Supports Corp, Figures 605, 606, 607, or 608
3. Anvil International, Figure 194,195, and 199
4. Equal as approved by the professional.

2.13 SUPPORT OF PIPES AT MECHANICAL EQUIPMENT CONNECTIONS

A. All piping 3" or larger connected to mechanical equipment shall be mounted with steel spring isolators.

B. The first three hangers or mounts near the mechanical equipment shall have the same static

deflection as specified for the mountings under the connected equipment and shall be Mason Industries type PC30N (or approved equal).

C. The first three hangers or mounts near the mechanical equipment, with no mountings under the equipment, shall be isolated by Mason Industries type 30N (or equal) hangers.

D. Floor supported piping shall rest on restrained mounts, Mason Industries type SLR-MT (or approved equal).

E. All other spring hangers and mounts, where specified, shall have a minimum static deflection of 3/4".

2.14 ANCHORS, GUIDES AND EXPANSION LOOPS

A. Anchors and guides shall be constructed of structural members, pipe, and steel plates. Members shall be properly welded together with all corners mitered. Anchors and guides shall be bolted to structural members or joists. Anchors, guides, expansion joints, and expansion loops shall be installed to provide for proper expansion of piping.

2.15 RIGID ANCHOR

A. Rigid anchors shall be shop or field fabricated as indicated on the drawings.

2.16 SLIDE SUPPORT

A. Acceptable Manufacturers:

1. Anvil Fig. 257, Type 1 (Basis of Design)
2. Modern Pipe Supports
3. Basic-PSA
4. Equal as approved by the professional.

B. Material: Galvanized carbon steel tee, carbon steel slide plates and galvanized carbon steel base.

C. Maximum Temperature: 750ºF.

D. Required Features:

1. No lubrication, graphite, or Teflon coatings required.
2. Permits 3” of insulation. Provide increased tee heights as required.
3. Weld in place design.

2.17 GUIDE SUPPORT

A. Acceptable Manufacturers:

1. Anvil Fig. 257, Type 3, (Basis of Design)
2. Equal as approved by the professional.

B. Material: Galvanized carbon steel tee, carbon steel slide plates and galvanized carbon steel base.

C. Maximum Temperature: 750ºF.

D. Required Features:

1. No lubrication, graphite, or Teflon coatings required.
2. Permits 3” of insulation. Provide increased tee heights as required.
3. Weld in place design.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install hangers and supports in accordance with the IBC and ASME B31.1.

B. All piping shall be supported from the building construction by the use of beam clamps, concrete inserts, brackets, or other equipment as dictated by the type of building construction.

C. Trapeze type hangers may be used for multiple parallel line installations. The Contractor shall submit sketches for the proposed hangers indicating the type of construction, number and size of lines, and maximum spacing to the Construction Manager and the Professional for approval.

D. ALL hanger and support locations shall be coordinated and reviewed with the Professional, Structural, HVAC, Electrical and Fire Protection Engineer Construction Representatives during construction. If any hanger locations or connection methods are unacceptable to any of the professional team (for example – penetrations of pre-cast concrete tees, from piping, uneven spacing or height, etc.), the Contractor shall relocate the support, at his own expense, to an approved location.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install guide(s) as indicated on each side of pipe expansion loops to properly isolate and control expansion in each respective pipe segment.

C. Attach guides to pipe and secure guides to structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.3 UNACCEPTABLE HANGER AND SUPPORT INSTALLATIONS

A. It is unacceptable to support any pipe(s) or duct(s) from other pipe(s) or duct(s).

B. If unistrut is used to support piping, strap hangers are unacceptable since they do not allow for continuous insulation.

C. It is unacceptable for this Contractor to support his work from the hangers of other trades. All trades must install their own hangers.

D. It is unacceptable to attach supports to the building structure or concrete slabs using nails or a nail gun.

E. It is unacceptable to support pipes using cable hangers.

F. Unacceptable hanger and support installations shall be corrected as directed by the Professional at no cost to the Client Agency.

G. Unistrut is not acceptable to support pipes equal to or greater than 3 inches in diameter.

H. Riser clamps placed on floor construction in finished areas, including stairwells, are not permitted.

I. Strap hangers, wire hangers, or split-ring hangers are not acceptable.

J. Perforated band iron, strap, split ring, wire, chain, or pipe hooks are not permitted for hangers or supports of pipe.

K. Piping shall not be supported from any other piping systems, ductwork, conduit, etc.

L. Attachments to, and penetrations of new or existing concrete structural tees for hanger connections shall be not be permitted until reviewed and approved by the Professional and Structural Engineer. The Contractor shall be responsible for the expense of all repairs required because of the installation of unauthorized attachments to, or penetrations of new or existing concrete structural tees.

M. It is unacceptable to torch burn holes in structural steel to attach support components. All holes in structural steel must be approved by the engineer and drilled.

N. Pipe roller supports shall not be used.

END OF SECTION 23 0529

SECTION 23 0548 – SOUND AND VIBRATION CONTROL - HVAC

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SCOPE

A. The sound and vibration control for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.1 VIBRATION AND NOISE CONTROL

A. All equipment shall operate without objectionable noise or vibrations within Noise Criteria Curves listed in Sound and Vibration Control of the latest edition of the ASHRAE Handbook of HVAC Applications. Sound and vibration measurements shall conform with the ASHRAE Handbook of Fundamentals. If such objectionable noise or vibration shall be produced and transmitted to occupied portions of the building by apparatus, piping, ducts or other parts of this work, any necessary changes, as approved, shall be made without cost to the Client Agency. Noise levels shall conform with the requirements of OSHA.

B. All mechanical equipment shall be isolated in accordance with the Latest Edition of the ASHRAE Handbook of HVAC Applications. Piping for the first three (3) support points away from remotely located mechanical equipment shall be isolated with Type 2 Isolators with a minimum deflection of 1.0 inches. All vibration isolators shall be of the same manufacturer where possible and shall be furnished by Consolidated Kinetics, Korfund, Vibration Eliminator Co. or equal as approved by the professional.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install vibration isolators, flexible connectors, etc per manufacturers recommendations.

END OF SECTION 23 0548

SECTION 23 0553 – EQUIPMENT AND PIPING IDENTIFICATION - HVAC

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SCOPE

A. The equipment and piping identification for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.1 VALVE TAGS

A. The Contractor shall tag each new valve, controller, and other devices requiring adjustment and affecting the performance of equipment furnished under this Contract. He shall prepare a list giving the number of each valve, its location, and the equipment or portion of the system tagged. The list shall be enclosed in a metal frame with glass and shall be hung where directed. Tags shall be of aluminum or brass, 2" in diameter with numbers as large as possible and attached by short, small link aluminum or brass chains or "S" hooks. Numbers and tags shall be coordinated with those being installed under the Plumbing Contract.

B. Prepare a typewritten list giving the number of each valve, its location, and the equipment or portions of the system controlled. The list shall be enclosed in a metal frame with glass. The list shall be hung at location directed by the Professional.

2.2 EQUIPMENT IDENTIFICATION

A. Where valves, cleanouts, dampers, VVB’s, CVB’s, humidifiers, etc., are located above removable tile ceilings or above access panels the Contractor shall furnish and install identification labels on the corners of the access panels or the support grid of removable ceiling tiles. Labels shall be provided with the word "VALVES," "RELAY," "DAMPER," etc., so that the equipment may be readily located in the future. Additionally, label designations shall correlate with the equipment designations on the drawings.

B. Identification labels shall not exceed 3" in length and 1" in height. Black letters shall be 1/4" high on white background. Labels shall be manufactured of engraved Micarta or Bakelite with pressure-sensitive backing and shall be nonabsorbent, nonporous and colorfast. Adhesive backing shall be chemically compounded to hold tight and fast at wide temperature extremes. Labels shall be as manufactured by Seton Name Plate Company, Brady Co., Kimball Systems, or equal as approved by the professional. Labels shall be additionally secured with screws or rivets. Flexible plastic punched tapes will not be acceptable. Labels shall be coordinated with those being installed under other contracts.

C. All major pieces of HVAC equipment shall include, at a suitable and accessible observation point on the equipment, a manufacturer's stamped brass or aluminum identification plate, with all pertinent capacity data stamped on the plate. Identification plate shall include all specific data, such as model number, serial number, motor data, horsepower, capacities, sizes, amperes, power consumption, speed, flows in GPM, temperatures, working pressures, operating pressures, and similar factors as applicable. In addition, pumps shall include total head in feet and impeller sizes.

D. The Contractor shall be responsible for furnishing and attaching an identification plate for the above mentioned major equipment if not provided by the equipment manufacturer.

E. Equipment marking tags shall be engraved phenolic, 1/16" thick, four edges binded, black with white lettering. The tag shall be securely mounted to the equipment with minimum of two (2) - 3/8" long No. 3 screws. Tags shall provide such information as: "Exhaust Fan - EF1", "Air Handling Unit - AHU 1" and include "date of installation and project number".

F. All piping shall be labeled with appropriate service designation as indicated in the table below, as well as with flow arrows at every 20 ft intervals and at every change of direction:

1. Pipe Designations Table.

SERVICE	DESIGNATIONS
Domestic Cold Water	C.W.
Gas	GAS
Chemical Supply Pipes	(NAME)
Sanitary Drain	SAN
High Pressure Steam (100 PSI)	HPS – 100 PSI
High Pressure Return (100 PSI)	HPR – 100 PSI
High Pressure Steam (60 PSI)	HPS – 60 PSI
High Pressure Return (60 PSI)	HPR – 60 PSI
Low Pressure Return	LPR
Fuel Oil Supply	FOS
Fuel Oil Return	FOR

2. Piping identification system shall conform to ANSI A-13.1, Scheme for Identification of Piping Systems, using standard background colors.

G. The installations will not be considered acceptable unless identification plates and nameplates are attached.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install per manufacturers recommendations.

END OF SECTION 23 0553

SECTION 23 0700 – HVAC INSULATION

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SCOPE

A. The insulation for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Fiberglass insulation shall be as manufactured by Owens Corning, CertainTeed, Johns-Manville, Knauf, or equal as approved by the professional.

B. Manufacturer’s names are indicated herein to denote a standard of quality and type only. Products of other manufacturers not mentioned herein will be acceptable providing they meet the requirements of these Specifications in quality and type and are submitted according to Section 23 0506, Paragraph 1.4.

C. The materials, finish and adhesive herein specified, shall be listed and inspected by Underwriters Laboratories Incorporated. Covering, vapor barriers, and adhesives used in this application shall have a flame spread classification of not more than 25 and a smoke developed rating of not more than 50, based on tests in accordance with ASTM Standard E84, "Methods of Tests for Surface Burning Characteristics of Building Materials," except as hereinafter specified. Each product shall bear the label Underwriters Laboratories. Products used on this project shall be classified as "non-combustible" by NFPA.

2.2 HOT PIPING SYSTEM INSULATION

A. Hot piping systems shall include the following:

1. High Pressure Steam Supply and Return, HPS & R (100 PSIG)
2. Low Pressure Steam Return, LPR
3. Pump Discharge Condensate (PD)
4. Boiler Feed Water (BFW)
5. Drain piping
6. Relief valve piping
7. Vent piping

B. Hot piping system insulation, except where specified otherwise, shall be glass fiber pipe insulation with white Type ASJ jacket, Owens Corning FIBERGLAS™ pipe insulation or approved

equal. End and transverse joints shall be wrapped with factory-furnished sealing strips of same material as jackets. Horizontal laps and end joints shall be sealed down with Foster® 85-20™ Spark-Fas® Adhesive, non-flammable, vapor barrier adhesive.

C. Exterior hot piping Insulation shall be the same as specified for hot piping systems. Thickness shall comply with the table in Paragraph 2.4, but shall be no less than 2 inches. Insulation shall be covered with a Type ASJ jacket and a Childers 0.016" smooth aluminum exterior weatherproof jacket neatly banded and sealed in place.

2.3 COLD PIPING SYSTEM INSULATION

A. Cold piping systems shall include the following:

1. Cold Water Make-Up

B. Cold piping system insulation shall be glass fiber pipe insulation with white Type ASJ vapor barrier jacket, Owens Corning FIBERGLAS™ pipe insulation or approved equal. End and transverse joints shall be wrapped with factory-furnished sealing strips of same material as jackets. All horizontal laps and end joints shall be sealed down with Foster® 85-20™ Spark-Fas® Adhesive, non-flammable, vapor barrier adhesive.

C. Vapor barrier jacket shall have a vapor transmission of approximately 0.02 perms.

D. Exterior cold piping insulation shall be the same as specified for cold piping systems. Thickness shall comply with the table in Paragraph 2.4, but shall be no less than 2 inches. Insulation shall be covered with a Type ASJ vapor barrier jacket and a Childers 0.016" smooth aluminum exterior weatherproof jacket neatly banded and sealed in place.

2.4 INSULATION THICKNESS AND THERMAL CONDUCTIVITY

A. Insulation thickness shall comply with the following table for the pipe service and fluid temperatures indicated:

Minimum Pipe Insulation Thickness, Inches								
Pipe Designation	Fluid Temperature Range, °F	Insulation Conductivity		Nominal Pipe or Tube Size, Inches				
		Conductivity, k, BTU • IN / HR FT^2 • °F	Mean Rating Temperature, °F	< 1	1 to < 1½	1½ to < 4	4 to < 8	≥ 8
HPS & R (> 15 - < 120 PSIG)	251 – 350	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
LPS & R (≤ 15 PSIG) PD, BFW	201 – 250	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
Drain, Relief Valve, and Vent Piping	141 – 200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
	105 – 140	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5

For piping smaller than 1½ inch and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted, but not to a thickness less than 1 inch.

2.5 HOT PIPING SYSTEM EQUIPMENT INSULATION

A. The following shall be insulated with 2.5” thick tank insulation and jacketing as specified for hot piping systems.

1. Flash Tanks
2. Deaerator
3. Condensate Surge Tank
4. Condensate Pump Tanks
5. Steam Separators

B. Tank insulation shall be FIBERGLAS™ Pipe and Tank Insulation as manufactured by Owens Corning or equal as approved by the professional.

C. Tank insulation shall be cut and mitered as necessary to fit the shape of the tank and shall be banded in place in strict accordance with the manufacturer's requirements. Joints shall be pointed with insulating cement.

D. Joints shall be pointed with insulating cement. Insulation for the equipment shall be covered with an all service jacket (ASJ) with seams overlapped and sealed with Foster® 85-20™ Spark-Fas® Adhesive, non-flammable, vapor barrier adhesive and vapor barrier tape.

2.6 HOT PIPING SYSTEM FITTINGS

A. Fittings on Interior Hot Piping Systems shall be insulated with fiberglass, factory-fabricated pipe fitting insulators the full thickness of pipe insulation. Insulation fittings shall be held in place with glass gauze wired on or stapled. Gauze shall be covered with a fire-resistant white coating applied in two equal coats in the amount of four gallons per each 100 sq. ft. by brush or spray to entire fitting surface like Foster® 30-35™ Tite-Fit™. Coating shall be covered with a flameproof canvas sealed in place. Canvas shall be wrapped on and sealed with Benjamin Foster flame resistant sealer. Cloth shall be applied after coating has dried.

B. Valves, flanges, and unions on steam lines and related piping systems shall be insulated like Paragraph “A” above, including those on the following lines:

1. High Pressure Steam Supply and Return, HPS & R (100 PSIG)
2. Low Pressure Steam Return, LPR
3. Pump Discharge Condensate (PD)
4. Boiler Feed Water (BFW)

C. Flanged and Union Connections and Valves on Hot Piping Systems shall not be insulated, except for steam lines and related piping systems. Insulation, however, shall be neatly tapered at flanges, unions and valves with insulating cement, and held in place by flameproof canvas wrapped on and pasted, as specified for fittings. Flanges and union connections and valves on cold water piping shall be insulated like that herein specified for chilled water lines except thickness shall be equal to the adjacent pipe insulation.

2.7 COLD PIPING SYSTEM FITTINGS

A. Fittings, Flanges and Valves on Cold Piping Systems shall be insulated with Insul-Coustic Insul-Sure or approved equal pre-molded fiberglass fittings. Pre-molded fittings shall be held in place with glass reinforcing cloth and insulating cement. Cloth shall be covered with a fire-resistant white vapor barrier coating applied in two equal coats in the amount of four gallons per each 100 square feet by brush or spray to the entire surface. Vapor barrier coating shall be Foster® 30-35™ Tite-Fit™ Coating, or approved equal. Coating shall be covered with 8 oz. flameproof canvas jacket sealed in place. It is the intent of these specifications that piping and equipment in contact with the chilled water be insulated for such use. This includes pump casings, valves and any other item where condensation is expected.

2.8 COMMON INSULATION REQUIREMENTS FOR PIPING SYSTEMS

A. Seams, overlaps and end joints shall be thoroughly sealed down with Foster® 85-20™ Spark-Fas® Adhesive or Foster® 85-75 Drion® Contact Cement vapor barrier adhesive as required. Ends of pipe insulation shall be sealed off at valves, fittings, flanges and every 20'-0" on straight runs with Foster® 30-35™ Tite-Fit™ Coating. The entire installation shall be sealed and free of condensation.

B. Insulation shall be applied with Bostitch outward clinched staples, one every 3" and four at each butt strap.

C. In lieu of pre-molded insulation fittings, the Contractor will be permitted to insulate pipe fittings with mitered and segmented fiberglass pipe insulation with elbows and changes of direction mitered, segmented and rounded to a thickness equal to the adjacent insulation, and thoroughly sealed and wrapped. Square cornered mitered joints will not be permitted. Field applied mitered and rounded insulation shall be held in place with reinforced glass cloth and vapor barrier insulating cement applied as specified above for pre-molded fittings. Coating shall be covered with 8 oz. flameproof canvas jacket sealed in place.

D. Insulation shall be applied over clean dry surfaces with the pipe at approximately room temperature. The installations shall be sealed and shall be free of condensation.

E. Fittings including tees, 90 degree fittings, 45 degree fittings, etc., shall be covered in strict accordance with the recommendations of the manufacturer of the pre-molded insulators. Joints and overlaps at fittings shall be buttered with fire resistant vapor barrier sealer.

F. In lieu of the pre-molded fittings previously specified herein, pre-molded one-piece PVC insulated fitting covers, with factory-precut and marked fiberglass All-Temp insulation, Zeston® 2000 PVC, as manufactured by Johns Manville, will be acceptable. Insulation shall fully cover the fitting and the covers shall be stapled and taped in place. Tapes shall be off-white and shall be of the pressure sensitive type furnished by the fitting manufacturer. Bands are not permitted. Ends shall be overlapped. Fittings on cold piping systems shall have all edges sealed with Zeston® Fire-resistant vapor barrier adhesive. The circumferential edges shall be wrapped with Zeston® fire-resistant vapor barrier sensitive Z-tape. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2" on the downward side. Cold pipe system fittings shall have at least two layers of factory-precut All-Temp insulation inserts. Installations shall be sealed and free of condensation. Fittings shall be installed in strict accordance with the fitting manufacturer's recommendations and details. Twine shall be used for securing insulation at chilled water and cold water installations.

G. Where certain thicknesses of pre-molded fitting insulators are not available from the manufacturer, the fitting insulation shall be one size smaller than the pipe insulation and shall be built up to the correct thickness with vapor barrier cement. Where necessary, fitting shall be mitered and segmented to a thickness equal to the adjacent insulation and shall be sealed and wrapped. Pre-molded fittings shall be installed to the satisfaction of the Architect, and shall be removed and replaced at the direction of the Architect where the installation is not completed in a neat and workmanlike manner. Pre-molded fittings shall have surfaces level, smooth and uniform without bulges, changes in thickness or uniformity.

H. Pipe covering shall not be installed on flanged or screwed fittings until connections have been tested and are free of leaks.

I. Insulation on piping shall extend full size through oversized floor, ceiling or wall sleeves. Piping shall be fully insulated except where specifically mentioned otherwise.

J. Glass cloth, fireproof canvas, vapor barrier sealer and adhesive shall be of types which can suitably be painted.

K. In lieu of sealing all-service jackets with a field applied vapor barrier adhesive, the Contractor may use factory applied pressure sensitive laps provided the pressure sensitive laps are guaranteed to remain sealed for the life of the insulation. Guarantee letters must be submitted in triplicate from the insulation manufacturer and the Heating Contractor. In lieu of the lifetime guarantee, the Contractor may use factory applied sensitive laps and additionally staple overlaps as hereinbefore specified.

L. Branch piping in confined equipment spaces where approved by the Architect, may be insulated with 3/4" thickness Armaflex FR fire resistant flexible tubing insulation if desired. Ends and joints shall be thoroughly sealed. Armaflex FR flexible tubing insulation shall not be installed in any other locations.

2.9 PIPE HANGERS AND STRUCTURAL MEMBERS

A. Pipe Hangers supporting cold piping systems shall be insulated separately in the same manner as fittings. The insulation shall be applied upward along the vertical hanger rod to a point not less than 6" above the pipe and sealed off in a neat and symmetrical manner. ½" thickness Armaflex FR flexible tubing insulation may be used in lieu of fiberglass at pipe hangers. Riser clamps and other supports directly in contact with chilled water piping shall be thoroughly insulated similar to that specified above.

B. Structural members and metal supports or equipment in direct contact with cold piping systems shall be insulated separately with 1-1/2" thick fiberglass blankets with vapor barrier jacket, securely fastened and covered with 8 oz. flameproof canvas. The insulation shall be applied along the members to a point not less than 6" above the pipe and sealed off in a neat and symmetrical manner. Venturi flow stations shall be insulated similar to the above, except at meter connections. Exposed disconnect valves and shutoff valves shall be wrapped with anti-sweat tape and covered with 8 oz. flameproof canvas.

C. Insulation shall be continuous at hangers and supports on piping. Extend insulation over pipe and hangers and thoroughly seal joint with a permanent pliable vapor barrier sealer such as Foster Elastolar® Sealant 95-44, or approved equal.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

A. Insulation shall be installed by an Insulation Subcontractor responsible to the 0.2 Contractor. Insulation shall be installed in a neat and workmanlike manner by workmen skilled in the installation and handling of commercial and industrial insulation for piping, ductwork, and equipment.

B. Insulation shall be installed as recommended by the insulation manufacturer.

3.2 PIPING SYSTEMS

A. Insulation shall be applied on clean, dry surfaces after pressure testing and approval. Insulation shall be continuous, including through wall and ceiling openings and sleeves. Insulation on piping systems operating at 60 degrees or less shall be maintained with a continuous unbroken vapor seal. Hangers, supports, anchors, guides and equipment shall be insulated and vapor sealed to prevent condensation.

B. Covered pipe shall be located a sufficient distance from walls, other pipes, ductwork, and other obstacles to permit the application of the full thickness of insulation specified; and if necessary, extra fittings and pipes shall be used.

C. Fiberglass insulation shall be installed with Bostitch outward clinched staples, one (1) every 3" and four (4) at each butt strap.

D. Insulation shall not be applied to any piping or equipment until pressure tests have been performed and approved by the Architect. Surfaces shall be clean and dry when insulation is installed.

E. Piping located in walls, in pipe chases, in crawl spaces, or above ceilings shall be considered as concealed. Other locations shall be considered as exposed unless otherwise specified herein.

F. Insulated piping (including piping with vapor barrier jacket) shall be wrapped with factory applied ASJ all-service jackets securely sealed in place with Benjamin Foster fire-resistant sealer. All-service jackets shall be heavy density, white, suitable for operating temperatures from –60 degrees F. to +450 degrees F., with vinyl coated and embossed vapor barrier laminate. All-service jackets shall be the Owens-Corning Fiberglass ASJ-25, or approved equal. All-service jackets shall have a vapor transmission rating of approximately .02 perms.

G. Piping furnished and installed under this Contract shall be insulated unless specifically indicated otherwise.

H. Exposed hot and chilled water piping in the boiler and chiller rooms shall be provided with PVC covers for a neat and professional appearance.

END OF SECTION 23 0700

SECTION 23 0900 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS, REQUIRED COORDINATION/CLARIFICATIONS

A. BMS Sub-Contractors/Vendors are <u>not</u> allowed to contact the Client Agency during the bidding of this project or they will be excluded from bidding the project no matter if their name is in the specification or not. All questions or comments shall be directed to the Professionals.

B. Drawings and General Provisions of the contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

C. All work of this Section shall be coordinated and provided by the single Boiler Management System (BMS) Sub-Contractor.

1. Throughout these specifications, any reference to “BMS Sub-Contractor”, "ATC Sub-Contractor", "BAS Control Sub-Contractor", "Controls Sub-Contractor" or “local field office” shall be interpreted as referring to the Boiler Management System (BMS) Sub-Contractor who shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Boiler Management Systems as further defined for this project by Sections 230900 and 230993 of these contract documents.

D. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other sections/trades. Reference all Division 23 and Division 26 Sections.

E. The work of this Section shall be as required by the Specifications, Drawings, Point Schedules, Sequences of Operation and Mechanical Systems Commissioning activities.

F. The contract documents and the sequences of operation are for conveying general concept only and are not meant to be inclusive of all hardware requirements or all functional sequence requirements. Refer to the complete package of contract drawings. Items mentioned in Sections 230900 and 230993, shown on the contract documents, mentioned in the sequences of operation, or shown on other HVAC drawings shall become part of the work of this project without the necessity of being separately detailed in each of those applicable sections of the contract documents. Reference in one section of the contract documents shall be interpreted to include reference in all other applicable sections. Any additional hardware and/or software required to accomplish functional intent shall be provided (without additional cost to the Client Agency) just as though it were fully detailed throughout the contract documents.

G. Safeties shall be both hardwired to their associated starter or VFD and wired as an input to the controls system. Each safety shall be wired to its associated controller I/O panel to operate a discrete multi-pole relay. Each safety shall be wired as normally closed and energize its associated multi-pole relay coil under normal conditions. One set of relay contacts shall be wired as an input into the control system to provide safety status. Another set of contacts shall be series hardwired with the other associated fan safeties to provide a fan system hardwired safety shut down.

H. HOA switches will be required for all outputs on major (i.e. nonterminal) equipment. Analog outputs shall also include a potentiometer for output signal adjustment when in the manual mode.

I. The point lists indicate hardwired monitoring/control points for each VFD. In addition, each new VFD shall make available to the control system, via the drive communication interface, the full list of available performance parameters for inclusion as part of the graphic display data for the VFD. The BMS Sub-Contractor shall be responsible for implementing BACnet communication to the new VFDs and integrating the full list of available performance parameters as part of the control system database. New VFDs shall be provided with BACnet communication capability fully implemented.

J. Each product or group of products manufactured by a different manufacturer, that is to be connected to the control system via a BACnet MS/TP communication interface, shall be placed on its own separate dedicated communication bus that originates at a network controller and is extended and connected to only the identical product operating at identical communication protocol and communication speeds. Downgrading the communication speed of a controller/device so it can reside on an MS/TP bus with slower communicating controllers/devices is not acceptable.

K. If the BMS Sub-Contractor believes there are conflicts or missing information in the project documents, the BMS Sub-Contractor shall promptly request clarification and instruction from the design team prior to the submission of bids.

L. Where conflict exists among sections 230900 and 230993 and the contract drawings, and questions were not raised during the bidding period to obtain clarification, the most stringent interpretation shall apply thereafter.

M. The listing of specific manufacturers hereinafter does not imply acceptance of their products that do not meet the specified construction, performance, feature and function requirements. Listed manufacturers are not relieved from meeting these specifications in their entirety.

N. The control system shall monitor all applicable (as determined by the Professional) points available through the various equipment/system communication interfaces and VFD communication interfaces defined by Sections 230900 and 230993 and treat those data points as database entries for purposes of graphic display, trending, alarming, etc.

O. Where required, the BMS Sub-Contractor shall provide all interlock control wiring between the fan motor disconnect auxiliary contacts and the associated VFD. The auxiliary contacts shall signal the VFD when the equipment has been shut down by the local disconnecting means.

P. Power – Data Drops Coordination

1. The design drawings indicate power and data connections for control system throughout the building. See the electrical drawings where the power and data connections are shown provided by the E.C. Should the BMS Sub-Contractor revise the locations of these connections it is their responsibility to coordinate with the E.C. to get power and data to the locations they need. Should this coordination not happen, it is the responsibility of the BMS Sub-Contractor to provide power and data as needed to complete their system at no additional cost to the project. The control system shall be “fully functioning on this project.”
2. If the control system power requirements exceed circuit capacity or circuit quantity as provided by the contract documents, the BMS Sub-Contractor shall then extend additional power wiring, complete with required breakers, from an electrical panel, as approved by the professional, at no additional cost to the Client Agency. Where a control device or any 3rd party integration device requires power and no trade is noted as providing that power on the contract documents, the BMS Sub-Contractor shall provide all required power

wiring, complete with breakers (where required), from an electrical panel as approved by the professional, at no additional cost to the Client Agency.

3. If the control system needs additional data connections as provided by the contract documents, the BMS Sub-Contractor shall then extend additional data wiring, switches and routers as required from a server rack, as approved by the professional, and coordinated with the Client Agency's IT department at no additional cost to the Client Agency. Where a control device or any 3rd party integration requires data and no trade is noted as providing that connection on the contract documents, the BMS Sub-Contractor shall provide all required wiring, switches and routers as required from the nearest server rack to allow network access to that device as approved by the professional and coordinated with the Client Agency's IT department., at no additional cost to the Client Agency.

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BY, BUT INTEGRATED WITH THE WORK OF, THIS SECTION

A. General:

1. Coordination Meeting: The BMS Sub-Contractor shall meet with the supplier(s) furnishing each of the following products to coordinate details of the interface between these products and the control network. The Client Agency or his designated representative shall be present at this meeting. Each supplier shall provide the Client Agency and the BMS Sub-Contractor with details of the proposed interface including PICS for BACnet equipment, hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BMS network. Submittals for these products shall not be approved prior to the completion of this meeting.

1.4 CONTROL SYSTEM DESCRIPTION

A. It is the intent of this project to provide a web accessible, interoperable control system based on server/thin client architecture, with support for multiple communication protocols, and designed around the open standards of web technology. In addition to other capabilities described hereinafter, the control system shall include full programmability of all connected nodes (controllers provided by the BMS Sub-Contractor) via the web for an authorized user. An authorized user shall also be able to create/edit graphic screens, trends and alarms without the need for any additional hardware and/or software. Coordinate with the Client Agency's IT department for Ethernet communication cabling requirements and TCP/IP addresses. Ethernet drops to the automation level network controllers and workstation/servers and connection to the Client Agency's network shall be provided by the Electrical Contractor.

B. The entire control system network shall be fully functional for the start-up, check-out, and commissioning processes. In order to achieve that end result, the BMS Sub-Contractor shall provide all temporary Ethernet infrastructure necessary for full operation of the BMS network prior to availability of the Client Agency's Ethernet network. The BMS Sub-Contractor shall complete changeover to the Client Agency furnished network and remove any temporary infrastructure when the Client Agency's network is made available for use by the control system.

C. The control system shall include, but not limited to:

1. Steam Boiler System
2. Graphical Programmer
3. Graphical User Interface(s) (GUI)
4. Workstation Server Hardware Station

D. All points of user interface shall be on standard PCs that do not require the purchase of any

special software from the control system manufacturer for use as a building operation terminal. The primary point of interface on these PCs will be a standard Web Browser.

E. Servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft SQL Server.

F. The work of the BMS Sub-Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Drawings, Point Lists, and Sequences of Operation and the associated interfacing work as referenced in the related documents.

G. The control system work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents, which are required for the complete, fully functional and commissioned control system.

H. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

I. The BMS Sub-Contractor shall have on-site personnel capable of making programming and hardware changes to the control system throughout the commissioning process.

J. Manage and coordinate the control system work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

K. The control system as provided shall incorporate, at minimum, the following integrated features, functions and services:

1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Diagnostic monitoring and reporting of control system functions.
5. Offsite monitoring and management access.
6. Energy management
7. Standard applications for terminal HVAC systems.
8. Mechanical and Electrical System Integration with the control system
9. Trending: Trend sample intervals shall be coordinated at commissioning.

L. All controllers (provided by the BMS Sub-Contractor) shall be fully field programmable by the Client Agency to allow for field customization, both now and in the future, to meet the Client Agency’s exact control strategy requirements and address ongoing changes in those requirements. In addition, an authorized user shall also be able to create/edit graphic screens, trends and alarms, upload/download NAE, Field Equipment Controllers, Input/Output Modules, monitor all BACnet Objects including but not limited to Analog and Digital Inputs/Outputs/Values, monitor and override all controller physical input/output points, and edit controller resident time schedules, all without the need for any additional vendor interaction. All hardware and software tools and accessories required to provide the Client Agency with these capabilities shall be furnished as part of this project. NO EXCEPTIONS

M. All access codes, passwords and logins shall be as per the Client Agency requirements. The Client Agency shall not be locked out of any portion of the system or network. NO EXCEPTIONS.

N. All hardware and software shall be provided with required licensing registered under the Client Agency's name, valid for the life of the project. The licensing shall provide the Client Agency the ability to allow unrestricted access and reprogram ability to whomever the Client Agency provides system access to.

O. The BMS Sub-Contractor shall provide a full complement of software tools and associated training (and hardware where software keys or other proprietary devices are involved) for use during commissioning.

P. The BMS Sub-Contractor shall provide separate MSTP buses for each grouping of DDC controllers and associated devices so that each controller/device shall communicate at its maximum rated communication baud rate. Downgrading the communication speed of a controller/device so it can reside on an MSTP bus with slower communicating controllers/devices is not acceptable.

1.5 QUALITY ASSURANCE

A. General

1. The BMS Sub-Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated control system. Throughout this specification, any reference to "ATC Contractor", "BAS Control Contractor", or "Controls Contractor" shall be interpreted as referring to the Boiler Management System Sub-Contractor.
2. The term "manufacturer" when used to identify an automatic temperature control sub-contractor/supplier, shall mean the complete system of building energy management. Components of the completed system shall include but not being limited to, hardware equipment, engineering, wiring, installation, sequence of operations, network architecture, commissioning, training, software programming and warranty.
3. The BMS Sub-Contractor shall be a recognized national manufacturer, installer and service provider of BMS.
4. Franchised dealers, or HVAC Contractors installing their own controls will not be accepted. NO EXCEPTIONS.
5. The BMS Sub-Contractor shall supply complete maintenance and support services on a 24 hour, 7-day-a-week basis.
6. As evidence and assurance of the contractor's ability to support the Client Agency's system with service and parts, the contractor must have been in the control business for at least the last ten (10) years.
7. The control system architecture shall consist of the products of a manufacturer regularly engaged in the production of control systems, and shall be the manufacturer's latest standard of design at the time of bid.

B. Workplace Safety and Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents.
2. The BMS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and subtrades comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA having jurisdiction for at least each topic listed in the Safety

Certification Manual.

5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Client Agency within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the Authority Having Jurisdiction (AHJ) at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide control system Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:

    a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
    b. Manage the financial aspects of the controls Contract.
    c. Coordinate as necessary with other trades.
    d. Be responsible for the work and actions of the control system workforce on site.

D. Domestic Engineering and Programming

1. The BMS Sub-Contractor shall provide domestic engineering and programming of the system. Engineers and programmers shall live in the United States of America and shall be familiar with the climate in the north eastern United States of America. Foreign engineers and programmers shall not be acceptable.
2. All engineering and programming on this project are custom to this specific project. Canned programs (used on the last job) shall not be acceptable.

E. BMS Sub-Contractor On-Site Personnel and Schedule

1. This project has a contractual schedule. The BMS Sub-Contractor must meet the project schedule. Should the BMS Sub-Contractor be behind schedule and there is less than four (4) BMS Sub-Contractors on site working toward project completion, no progress payments will be issued until the controls work is complete and back on schedule. Project completion includes successful commissioning of systems.

F. Pre-Installation Meeting

1. The BMS Sub-Contractor shall arrange and hold a pre-installation meeting. The pre-installation meeting will be held after the review and acceptance of the BMS System submittals.
2. The BMS Sub-Contractor, the Client Agency, the Architect, the Professional, the HVAC Contractor, the Electrical Contractor, and all other associated parties shall be present at the pre-installation meeting.

3. The BMS Sub-Contractor shall specifically address the project schedule and his detailed plan to complete this project on time per the contractual schedule. Project completion includes completion of Commissioning.

G. Schedule of Values

1. The HVAC Contractor's schedule of values after award shall include the following breakdown for controls system controls as a minimum.

a. Control system Engineering and Submittals

1) Limited to 7.5% of the overall control system cost
2) Request for payment for engineering and submittals shall not be made until all submittals are reviewed and accepted.

b. Steam Boiler System – Controls (hardware and wiring installation)
c. Steam Boiler System – Programming
d. Steam Boiler System – Commissioning
10% of the base unit controls cost shall be withheld until commissioning is complete.

1.6 REFERENCES

A. All work shall conform to the following Codes and Standards, as applicable:

1. National Fire Protection Association (NFPA) Standards.
2. National Electric Code (NEC) and applicable local Electric Code.
3. Underwriters Laboratories (UL) listing and labels.
4. UL 864 UUKL Smoke Control
5. UL 268 Smoke Detectors.
6. UL 916 Energy Management
7. NFPA 70 - National Electrical Code.
8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
9. American National Standards Institute (ANSI).
10. National Electric Manufacturer's Association (NEMA).
11. American Society of Mechanical Engineers (ASME).
12. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) and ASHRAE 62 IAQ as applicable.
13. Air Movement and Control Association (AMCA).
14. Institute of Electrical and Electronic Engineers (IEEE).
15. American Standard Code for Information Interchange (ASCII).
16. Electronics Industries Association (EIA).
17. Occupational Safety and Health Administration (OSHA).
18. American Society for Testing and Materials (ASTM).
19. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
20. Americans Disability Act (ADA)
21. ANSI/ASHRAE Standard 195-2004 (BACnet)

B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.

C. All work shall meet the approval of the Authorities Having Jurisdiction (AHJ) at the project site. The control system vendor shall be responsible for gaining control system approval from the AHJ.

1.7 SUBMITTALS

A. Shop Drawings, Product Data, and Samples

1. The BMS Sub-Contractor shall submit shop drawings within 90 days of contract award. Shop drawing submittal shall be complete for the full scope of the project work and shall be provided as ONE COMPLETE PACKAGE. Package shall include the work of Sections 230900 and 230993 in order to verify integrated performance requirements. Partial or incomplete submittals shall be returned unchecked.
2. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Sub-Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Client Agency.
3. **Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description**.

    a. **Sequentially numbered product data sheet section with an index identifying page(s) for each product utilized in the installed BMS system and product data sheet(s) for each product**. The index shall individually list each product with the associated numerically sequenced page number(s) of the product data sheets. For all products including software, provide product data sheet(s) or marked catalog pages that include part number, photo, complete specifications and numerically sequenced page number(s) referenced in the index. Where product data sheets apply to multiple devices, those devices specific to this project shall be clearly highlighted for ease of reference to the appropriate data. Failure to provide this highlight requirement shall cause the submission to be interpreted as an incomplete submittal which shall follow the rules for partial or incomplete submittals defined above.

4. The BMS Sub-Contractor shall correct any errors or omissions noted in any review submission.
5. Shop drawing submittals shall be complete and fully detailed so as to establish all required information to provide a fully engineered, coordinated and integrated distributed processing HVAC control system. All terminal-to-terminal and one-line wiring diagrams and flow diagrams shall be submitted in AUTOCAD or VISIO format (latest version). At a minimum, submit the following:

    a. Complete control system network architecture diagrams including all nodes, interconnections and interface to nodes not provided by the BMS Sub-Contractor but a control system communication interface required. Control system network architecture shall detail each controller, controller ID, controller location, system served, communication buses and type associated, sub-busses with connected sub-systems, etc. Control system network architecture diagrams shall include communication speeds for each bus segment.
    b. Sequentially numbered systems schematics, sequences and flow diagrams with an index identifying pages for each drawing for the project.
    c. Provide a schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, it shall be labeled with the same name. All terminals shall be labeled.
    d. Provide an instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number.
    e. Provide a complete layout, including point to point wiring requirements, of the internal panel hardware for any I/O panels installed in support of the BMS controllers.
    f. Include a complete description of the operation of the control system, including sequences of operation. The description shall include a schematic diagram of the controlled system.
    g. Provide a point list for each system controller including both input and output (I/O)

points, point number, the controlled device associated with the I/O point, and the location of the I/O device.

h. Project specific samples of Graphic Display screen types and associated menus for each type of HVAC equipment on the project. The BMS Sub-Contractor shall consult with the Client Agency, prior to shop drawing submittal, to determine Client Agency preference(s) for screen layout format and have the sample graphics reflect those preferences. For example, the Client Agency may prefer to have adjustable setpoint information always located in the upper left quadrant of the graphic and screen transfer points in the upper right corner.

i. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes including, but not limited to: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.

j. Details of all control system interfaces and connections to the work of other trades.

k. Listing of all read and or write points derived via interfaces to mechanical system components as required per project specifications, sequences of operation, points list(s), and/or required for correct systems operation and functionality. Points shall be identified as to point type (AI, BI, AO, BI, AV, BV), point source (read, write, commandable), interface type (Lon, BACnet, N2, etc.) point ID in control system and point ID in mechanical system, mechanical system source (VFD, etc.), point (object) name (% speed, fan status, etc.) and point description (speed of motor, fan on, etc.)

l. Provide and coordinate point/object naming conventions with the Client Agency. The naming convention shall be reviewed with and approved by the Client Agency and subsequently submitted with the control system Shop Drawings for review.

6. Submittals shall be developed in conjunction with the requirements of the Client Agency's commissioning process. In addition, all submittals, "as-builts" and O & M Manuals shall clearly indicate the location of all controllers and field devices (Example: in Room 123, above corridor ceiling outside Room 456, etc.).

1.8 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Client Agency's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the control system provided:

a. Table of contents.

b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.

c. Manufacturers product data sheets or catalog pages for all products including software.

d. System Operator's manuals.

e. Archive copy of all site-specific databases and sequences.

f. Control system network diagrams.

g. Interfaces to all third-party products and work by other trades.

2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

3. The Controls Contractor shall provide O & M manuals that are organized in a logical,

concise easy to use format. Where changes have occurred from the original submittal package, those changes shall be reflected on the appropriate unit/system/sub-system drawings and not just grouped as a series of partial drawings (i.e. changes only) at the end of the drawing package. In like fashion, new terminal devices shall be logically inserted into the specification data sheet sections according to the type of device(s) involved and not just grouped as a series of new pages at the end of the previous data sheet submittal section. In addition, the control system overview drawings shall accurately reflect "as-built" conditions, including the integration of communication nodes provided by other manufacturers/trades. To the extent that the original submittal package must be totally redone in order to satisfy these requirements, the Controls Contractor shall make the necessary changes at no additional cost to the Client Agency.

4. O & M Manuals shall be developed in conjunction with the requirements of Section 230800 Mechanical Systems Commissioning. In addition, all submittals, "as-builts" and O & M Manuals shall clearly indicate the location of all controllers and field devices (in Room 123, above corridor ceiling outside Room 456, etc.).

1.9 WARRANTY

A. Standard Material and Labor Warranty:

1. Provide a two (2) year labor and material warranty on the control system starting at date of final payment.
2. The local field office shall warranty all control system computers, controllers, software and related I/O equipment and all new electric hardware for a period of two (2) years from the date of final payment.
3. All equipment found to have defects in material or workmanship during this warranty period shall be replaced at no charge to the Client Agency with equipment of equal type and quality by the local field office. All labor required during the warranty period shall also be included, with the following clarification. Materials furnished but not installed by the BMS Sub-Contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade Sub-Contractor performing the installation.
4. Operator workstation/server software updates, project-specific software updates, graphic software updates, database software updates, and firmware updates which resolve known deficiencies as identified by the local field office and/or Client Agency shall be provided to the Client Agency at no charge during the warranty period. The local field office shall also keep current with manufacturer's software and firmware updates for the Client Agency's control system during the warranty period at no charge to the Client Agency.
5. The BMS Sub-Contractor shall respond to the job site within a 24-hour period for any warranty work relating to the control system.
6. Maintain an adequate supply of materials such that replacement of key parts and labor support, including programming, occurs in a timely manner. Warranty work shall be done during BMS Sub-Contractor's normal business hours.

PART 2 – PRODUCTS

2.1 STANDARD OF QUALITY

A. It is recognized that the control system design for this project, both hardware and software, represents a specific approach to addressing both Client Agency ease of operation and long term energy efficiency of the completed HVAC project. To that end, this specification clearly establishes MINIMUM hardware, software, installation, commissioning and man-machine interface requirements. While it is clear that there may be distinctions in how different ATC manufacturers configure their hardware and software approaches/solutions for this project, it must be pointed out that this specification establishes MINIMUM STANDARDS APPLICABLE TO ALL named manufacturers. Named manufacturers should not assume that just because they are named as an acceptable manufacturer, they can use lower level hardware and/or software

components to meet the functional intent of this specification. Where necessary, because a lower level panel or terminal device fails to satisfy ALL of the specification requirements, manufacturers shall use higher level hardware to satisfy specification requirements, even if all requirements are exceeded in the process. It remains the intent of this specification to require GREATER THAN OR EQUAL TO COMPLIANCE from all manufacturers.

B. The network architecture described hereinafter is that of the basis of design manufacturer and describes open protocol BACnet communication requirements at both the automation network level and the field controller network level. For named manufacturers who do not offer a BACnet solution at the controller level, use of LON controllers or proprietary controllers at the field controller network level is acceptable. However, all named manufacturers shall be required to utilize BACnet communications at the automation network level. NO EXCEPTIONS.

2.2 GENERAL DESCRIPTION

A. **The control system shall be a Web-Based system using an open architecture and fully support a multi-vendor environment**. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. **The system shall be designed for use on any computer via an Internet connection using off the shelf, industry standard technology compatible with other Client Agency provided networks**.

B. The system shall be a standard product with the manufacturer who will guarantee ongoing parts availability and factory trained field support for ten (10) years after system acceptance.

C. The control system shall consist of the following:

1. Network Automation Engine(s)
2. Field Equipment Controller(s)
3. Input/Output Module(s)
4. Local Display Device(s)
5. Distributed User Interface(s)
6. Network processing, data storage and communications equipment
7. Graphical Programmer
8. Graphical User Interfaces (GUI)
9. User Interface
10. Workstation Server Hardware Station
11. Other components required for a complete and working BMS

D. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

E. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

F. Acceptable Manufacturers

1. Basis of Design: Conexus
2. Tridium Niagara 4 Supervisor
3. Johnson Controls
4. Rockwell Automation
5. Or equal as approved by the Professional

G. The BMS Sub-Contractor shall supply to the Professional a subparagraph by subparagraph

specification compliance report during the submittal process. The compliance report shall address the requirements of both Section 230900 and Section 230993. As a minimum, the report shall indicate for each numbered subparagraph identified with a capital letter whether the BMS Sub-Contractor meets the criteria of the subparagraph. (Where exceptions and/or noncompliance are involved and additional levels of subparagraphs exist, it shall be necessary to go to the next level(s) of subparagraph(s) to provide the appropriate information.) Failure to heed this compliance report requirement, to the minimum level of detail specified, shall be interpreted to mean that the given control system fails to meet the specified criteria and/or intent and the associated bid may be rejected. NO EXCEPTIONS. The following format must be utilized in completing the compliance report:

1. Comply - without exception
2. Exception - Meet the functional intent. For each paragraph/subparagraph, the Sub-Contractor shall identify all differences in specific functions stated in the given paragraph/subparagraph and provide a description of what is excluded or how he intends to meet the function specified.
3. Does Not Comply - Cannot meet specified function and will not provide.

H. The BMS Sub-Contractor is hereby warned against indicating compliance with a given specification item at compliance report time and subsequently including a different non-compliant item at submittal time. References to “industry standard practices” shall not constitute a justification for such a change. Any deviations from the original specification compliance report, a copy of which shall be included with the shop drawing submittal, will not be accepted by the Professional. In addition, all “exceptions” and “does not comply” responses shall be explained in sufficient detail to the allow the Professional to evaluate the economic impact of the difference and judge if the impact creates an unfair advantage when pricing alone is the sole evaluation criteria for the overall system. The Professional reserves the right to require full unconditional compliance with any and all items deemed necessary and/or in the best interest of the project. All submittal data shall clearly indicate sufficient technical information to readily determine specification compliance.

I. The substitution provisions of other Sections of these specifications shall not be applicable to the work of these Sections – Instrumentation and Control for HVAC and Sequences of Operation for HVAC Controls. NO SUBSTITUTIONS. NO EXCEPTIONS.

J. The system shall be a standard product with the manufacturer who will guarantee ongoing parts availability and factory trained field support for ten (10) years after system acceptance.

K. The BMS Sub-Contractor shall provide a project specific control system Architecture Overview diagram within 24 hours of the bid opening. The architectural overview shall begin with the Client Agency provided network and include all servers/workstations, a riser-type diagram of all Ethernet switches and hardware panels utilized on the project, including 3rd party equipment being interfaced to the control system, at each communication bus level. Quantities and model numbers of the controllers involved shall be clearly indicated in order to facilitate evaluation of the proposed hardware solution in light of specification requirements. Specification data sheets for all controllers shall also be included. Overview diagram shall clearly indicate ALL network communication protocols used in the system for this specific project and the baud rate for each communication bus segment.

2.3 SYSTEM ARCHITECTURE

A. Automation Network

1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP.
2. The control system shall network multiple user interface clients, automation engines, system controllers and application-specific controllers. Provide application and data

server(s) as required for systems operation.

3. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
4. Network Automation Engines (NAE) shall reside on the automation network.
5. BMS Sub-Contractor shall be responsible for providing all labor and materials for implementing any portion of the automation network level required for this project that is not provided by the Client Agency.

B. Control Network

1. Network Automation Engines shall provide supervisory control over the control network and shall support the following communication protocol:

   a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.

2. Control networks shall provide either “Peer-to-Peer,” Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network.
4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
5. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
6. BMS Sub-Contractor shall be responsible for providing all labor and materials for implementing control network level required for this project.

C. Integration

1. BACnet Protocol Integration – BACnet

   a. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2003.
   b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
   c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.
   d. Any/all routers, switches, hubs and CAT 6 wiring required to implement BMS and/or integration to other systems shall be the responsibility of the BMS Sub-Contractor to furnish and install. All power and material required for operation of associated routers, switches and hubs shall be furnished and installed by the BMS Sub-Contractor from panels with spare circuit locations as approved by the Professional.

2. Typical VFD communication interface points shall include, as a minimum:

   BV VFD Status
   BV VFD Fault Condition ~
   AV VFD Motor Speed (RPM)
   AV VFD Speed Setpoint (Hertz)
   BV Motor Failure ~
   BV Motor Runtime *
   BV Minimum Runtime Exceeded ~
   AV VFD Output Speed (Hertz)
   AV VFD Motor Kilowatt Hours
   BV VFD in “Auto” ~
   BV VFD in “Off” ~
   BV VFD in “Hand” ~

BV VFD Over Current ~
BV VFD Over Voltage ~
BV VFD Under Voltage ~
BV VFD Ground Fault ~
BV VFD Input Line Supervision ~
BV VFD Output Phase Supervision ~
BV VFD Under Temperature ~
BV VFD Over Temperature ~
BV Motor Stalled ~
BV VFD External Fault ~
BV VFD Communication Bus Failure ~

2.4 USER INTERFACE

A. Dedicated Web Based User Interface

1. The BMS Contractor shall provide and install personal computers for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability. ADS/ADX Site Director software package shall be installed on PC by the BMS Contractor.
2. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically, it must be implemented to conform to the following interface standards.

    a. Microsoft Internet Explorer for user interface functions
    b. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions
    c. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
    d. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries.

3. PC Hardware

    a. One (1) personal computers shall be configured as follows subject to final approval by Client Agency's IT group

        Memory – 1 GB
        CPU – Pentium 4 processor. 2.8 GHz Clock Speed
        Hard Drive – 2 TB free hard drive space
        Hard drive backup system – CD/RW, DVD/RW or network backup software provided by IT department
        CD ROM Drive – 32X performance
        Ports – (2) Serial and (1) parallel, (2) USB ports
        Keyboard – 101 Keyboard and 2 Button Mouse
        CRT configuration – 2 CRTs as follows:

        1) Each Display – 17" Flat Panel Monitor 1280 x 1024 resolution minimum.
        2) 16 bit or higher color resolution
        3) Display card with multiple monitor support

    b. Additionally, provide a file server for control system backup. The Client Agency will

provide some direction in the size required.

c. Furnish two (2) laptop computers with full control system functionality for maintenance purposes.
d. The Client Agency will provide information from its IT group regarding the specifications for computers and servers.

4. Operating System Software

a. Latest version of Windows.
b. Where user interface is not provided via browser, provide complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.
c. Provide software registration cards to the Client Agency for all included software.

5. Peripheral Hardware

a. Reports printers - one (1) printer shall be provided:

1) Printer Make – Hewlett Packard DeskJet
2) Print Speed – 600 DPI Black, 300 DPI Color
3) Buffer – 64 K Input Print Buffer
4) Color Printing – Include Color Kit

6. Remote Viewing Panels

a. Two (2) remote viewing panels shall be provided by the BMS Sub-Contractor.
b. Remote viewing panels shall be slaves to the master BMS control panel. Remote viewing panels shall mirror the BMS system graphic for monitoring purposes only. Coordinate final location of viewing panels with the Client Agency.

B. Distributed Web Based User Interface

1. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
2. The software shall run on the Microsoft Internet Explorer (latest version) browser.
3. Minimum hardware requirements:

a. 256 MB RAM
b. 2.0 GHz Clock Speed Pentium 4 Microprocessor.
c. 40.0 GB Hard Drive.
d. 1 Keyboard with 83 keys (minimum).
e. SVGA 1024x768 resolution display with 64K colors and 16 bit color depth.
f. Mouse or other pointing device

C. User Interface Application Components

1. Operator Interface

a. An integrated browser based client application shall be used as the user operator interface program.
b. All Inputs, Outputs, Setpoints, and all other parameters as defined by the contract documents, or required as part of the system software, shall be displayed for operator viewing from the operator interface software.

c. The user interface software shall provide help menus and instructions for each operation and/or application.
d. All controller software operating parameters shall be displayed for the operator to view from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
e. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:

1) User access for selective information retrieval and control command execution
2) Monitoring and reporting
3) Alarm, non-normal, and return to normal condition annunciation
4) Selective operator override and other control actions
5) Information archiving, manipulation, formatting, display and reporting
6) BMS internal performance supervision and diagnostics
7) On-line access to user HELP menus
8) On-line access to current BMS as-built records and documentation Sequence of operation information, shop drawings and specifications data sheets associated with a system shall be available from the colorgraphic screen associated with that system. This feature shall be fully implemented for the colorgraphic screens created for this project.
9) Means for the controlled re-programming, re-configuration of BMS operation and for the manipulation of BMS database information in compliance with the prevailing codes, approvals and regulations for individual BMS applications.

f. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

2. Navigation Trees

a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
c. The navigation trees shall be “dockable” to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.

3. Alarms

a. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:

1) Log date and time of alarm occurrence.
2) Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
3) Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
4) Provide an audit trail on hard drive for alarms by recording user

acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.

5) Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable. BMS Contractor shall coordinate implementation of this feature with the Client Agency as part of the work of this project.
6) Any attribute of any object in the system may be designated to report an alarm.

b. The control system shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
c. The control system shall annunciate application alarms at minimum, as required by the Contract Documents.

4. Reports and Summaries

a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:

1) All points in the control system
2) All points in each control system application
3) All points in a specific controller
4) All points in a user-defined group of points
5) All points currently in alarm
6) All points locked out
7) All control system schedules
8) All user defined and adjustable variables, schedules, interlocks and the like.

b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.

5. Schedules

a. Schedules shall be set up by the BMS Sub-Contractor in conjunction with the Client Agency to meet the needs of the Client Agency.
b. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:

1) Weekly schedules
2) Exception Schedules
3) Monthly calendars.

c. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
d. It shall be possible to define one or more exception schedules for each schedule including references to calendars
e. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days

shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.

f. Changes to schedules made from the User Interface shall directly modify the Network Automation Engine schedule database.
g. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.
h. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.

6. Password

a. Multiple-level password access protection shall be provided to allow the user/manager to manage interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
b. Each user shall have the following: a user name (24 characters minimum), a password (12 characters minimum), and access levels.
c. The system shall allow each user to change his or her password at will.
d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
e. A minimum of five levels of access shall be supported individually or in any combination as follows:

1) Level 1 = View Data / Command / Operator Overrides
2) Level 2 = Database Modification / Database Configuration
3) Level 3 = All privileges, including Password Add/Modify

f. A minimum of 100 unique passwords shall be supported.
g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
h. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.

7. Screen Manager - The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.
8. Dynamic Color Graphics

a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
c. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:

1) All graphics shall be fully scalable
2) The graphics shall support a maintained aspect ratio.
3) Multiple fonts shall be supported.

4) Unique background shall be assignable on a per graphic basis.
5) The color of all animations and values on displays shall indicate if the status of the object attribute.

d. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device
e. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.

1) The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
2) In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.

f. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.

9. Historical trending and data collection

a. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:

1) Any point, physical or calculated, may be designated for trending. Two methods of collection shall be allowed:
2) Defined time interval
3) Upon a change of value
4) Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

b. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested by the user or on a time scheduled basis.
c. All trend sample intervals shall be coordinated with the Professional and shall be sufficient to support the needs of the commissioning process.
d. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in either Microsoft Access or SQL database format.

10. Trend data viewing and analysis

a. Provide a trend viewing utility that shall have access to all database points.
b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.

e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.

11. BMS Contractor shall provide and install all computer hardware and software required for the purpose of configuration and consolidation of information and programs required for the delivery of a Task Focused, Web Based Portal to the control system. This Ready Access Portal shall provide a natural, complementary extension to the site management user interface previously described.
12. Ready Access Portal Architecture – The architecture of the system shall be implemented to conform to industry standards, so that it can accommodate the required applications provided by the BMS Contractor as well as communicate information to and from the Site Director.
13. User Interface Application Components

    a. The ready access portal shall provide an intuitive user interface to key control system functions and tasks via web browser.
    b. Plug-ins or special software shall not be required for access to alarm, summary, schedule and trend data.
    c. The portal shall include the ability to view full graphical representations of systems and equipment on PC platforms
    d. The control system shall provide Secure Sockets Level (SSL) and Active Directory service support. If the Active Directory service and Single Sign-On features are enabled and the user is logged in to the Windows desktop, the login screen does not appear and access to the system is automatic.
    e. Provide a common tool for graphics creation, schedule creation, custom programming, user access and hardware definition
    f. Information shall be accessible on both personal computer as follows:

        1) Personal computers – Internet Explorer (latest version)

14. Operator Interface

    a. Password access shall be as described previously for management portal UI
    b. Once logged in, the System shall display a pre-selected screen tailored to the task requirements of the individual user.
    c. The User Interface shall utilize an intuitive navigation and display method designed for operators who access the system for casual information and control or on an infrequent basis. It shall feature three basic components.

        1) Radio buttons for selection of the type of information to be displayed including Alerts, Summary, Schedules and Diagnostics
        2) Navigation tree for selection of the specific data to be displayed on screen for the selected type. The navigation tree may be hidden and expanded by the operator to optimize the display of information
        3) A display window that provides the selected information by type in a pre-configured tabular format

    d. The user interface software shall provide help menus and instructions for each operation and/or application.
    e. The system shall provide support for up to 100 concurrent users with defined password access to the system
    f. The system shall utilize Secure Sockets Level (SSL) support as required to allow the

ready access portal to communicate across a network in a way designed to prevent eavesdropping, tampering, and message forgery. It provides endpoint authentication and communications privacy over the network using cryptography

g. The system shall have the capability to display multiple navigation trees that correspond to the user views configured in the management portal UI.

h. The alert summary of the remote access portal shall, at the minimum, provide the following information

1) Alert (Alarm) type
2) Date and time of alert occurrence
3) Priority (color coded to level)
4) Item name.
5) Item value (if applicable)
6) Message
7) Any attribute of any object in the system may be designated to report an alarm

i. A standard summary on the remote access portal shall, at the minimum, provide the following information

1) Point type graphic icon
2) Item name
3) Item value
4) Item status
5) Access to the Change Value window (if applicable) for the purpose of setting, holding or releasing an item value

j. The schedule detail summary of the remote access portal shall, at the minimum, provide the following information

1) Scheduled occurrences including time and value
2) Scheduled overrides including start time, end time and value
3) A list of all scheduled items including name and attribute, value, status and priority
4) Access to the Add Temporary Override window for the purpose of adding a temporary override to the schedule

k. The diagnostic (trend) summary of the remote access portal as viewed on the PC/remote computer device shall provide the following information.

1) Item name
2) Item status
3) Trend name
4) Trend status
5) Full path name
6) Access to trend detail summary including trended value, time and date arranged in a user selectable format of 1 hour, 12 hours, 24 hours, 48 hours or 72 hours

2.5 CONTROL UNITS – GENERAL

A. Provide an adequate number of control units to achieve monitoring and control of all data points specified and as necessary to satisfy the sequence of operation for all mechanical systems shown on the plans. Control units shall meet the following requirements.

1. Controllers shall be suitable for the anticipated ambient conditions.

a. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at -40°F to 140°F and 5 to 95% RH, noncondensing.
b. Controllers used in conditioned ambient space shall be mounted in dust-proof enclosures and shall be rated for operation at 32°F to 122°F and 10 to 90% RH, non-condensing.

2. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
3. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 ft.
4. Power fail Restart: Restart of field equipment after restoration of power and short cycle protection shall require manual intervention. Automatic restart of field equipment will not be accepted. In all cases, the controllers (both network level and field level) shall automatically resume proper operation following the return of power.
   In the event of the loss of normal power, there shall be an orderly shutdown of all Network Level Controllers/Routers to prevent the loss of database or operating system software. Non-Volatile memory shall be incorporated for all critical Network Level Controller/Router configuration data, and battery back-up shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours. Upon restoration of normal power, the Network Level Controller/Router shall automatically resume full operation.
   In the event of a loss of communication, the Application Controller shall control from a standalone algorithm which maintains the assigned space temperature until communication is restored.
5. The BMS Sub-Contractor shall provide controllers with unused Input/Output capacity such that input/output points can be added to any controller to achieve additional point capacity of 15% for each type of point (AI, BI, AO, BO, PI) currently part of the input/output configuration.

2.6 NETWORK AUTOMATION ENGINES (NAE)

A. Network Automation Engine

1. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed FECs and application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines. NAE shall support the BACnet services and objects typically used by a workstation and a field controller device, including BACnet alarm and event services. NAE shall communicate via the MS/TP bus with the FEC family of BACnet application specific controllers (B-ASC).
2. Automation network – The NAE shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface – Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.

   a. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
   b. The NAE shall support up a minimum of four (4) concurrent users.
   c. The web based user shall have the capability to access all system data through one NAE.
   d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.

e. Systems that require the user to address more than one NAE to access all system information are not acceptable.
f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:

1) Configuration
2) Commissioning
3) Data Archiving
4) Monitoring
5) Commanding
6) System Diagnostics

i. Systems that require workstation software or modified web browsers are not acceptable.
j. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

4. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of the Contract Documents.
5. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
6. Hardware Real Time Clock – The NAE shall include an integrated, hardware-based, real-time clock.
7. The NAE shall include troubleshooting LED indicators to identify the following conditions:

a. Power - On/Off
b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
c. Ethernet Connection Speed – 10 Mbps/100 Mbps
d. FC Bus A – Normal Communications/No Field Communications
e. FC Bus B – Normal Communications/No Field Communications
f. Peer Communication – Data Traffic Between NAE Devices
g. Run – NAE Running/NAE In Startup/NAE Shutting Down/Software Not Running
h. Bat Fault – Battery Defective, Data Protection Battery Not Installed
i. 24 VAC – 24 VAC Present/Loss Of 24VAC
j. Fault – General Fault
k. Modem RX – NAE Modem Receiving Data
l. Modem TX – NAE Modem Transmitting Data

8. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.

a. Two (2) USB port
b. Two (2) URS-232 serial data communication port
c. Two (2) RS-485 port
d. One (1) Ethernet port

9. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall

provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

10. Power Failure – In the event of the loss of normal power, the NAE shall continue to operate for a user adjustable period of up to 5 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

    a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
    b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

11. Certification – The NAE shall be listed by Underwriters Laboratories (UL).
12. Controller network – The NAE shall support the following communication protocols on the controller network:

    a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

        1) A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
        2) The NAE shall support a minimum of 100 control devices.

13. The Controls Contractor shall include at least one Network Automation Engine (NAE) for each major system or subsystem. The NAE controller and sensor/actuator communication buses shall be loaded such that only 75% of the available NAE resources are utilized during normal operation. This shall include full implementation of all trending and alarming as required by the contract documents. The Controls Contractor shall demonstrate compliance with this loading limitation to the Professional for all NAEs provided.

2.7 DDC SYSTEM CONTROLLERS

A. Field Equipment Controller

1. The Field Equipment Controller (FEC) with display shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
2. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
3. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
4. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
5. The FEC shall include a removable base to allow pre-wiring without the controller.
6. The FEC shall include troubleshooting LED indicators to identify the following conditions:

    a. Power On
    b. Power Off
    c. Download or Startup in progress, not ready for normal operation
    d. No Faults
    e. Device Fault
    f. Field Controller Bus - Normal Data Transmission

g. Field Controller Bus - No Data Transmission
h. Field Controller Bus - No Communication
i. Sensor-Actuator Bus - Normal Data Transmission
j. Sensor-Actuator Bus - No Data Transmission
k. Sensor-Actuator Bus - No Communication

7. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
8. The FEC shall support the following types of inputs and outputs:

    a. Universal Inputs - shall be configured to monitor any of the following:

        1) Analog Input, Voltage Mode, 0 - 10 VDC
        2) Analog Input, Current Mode, 4 – 20 mA
        3) Analog Input, Resistive Mode
        4) Binary Input, Dry Contact Maintained Mode
        5) Binary Input, Pulse Counter Mode

    b. Binary Inputs - shall be configured to monitor either of the following:

        1) Dry Contact Maintained Mode
        2) Pulse Counter Mode

    c. Analog Outputs - shall be configured to output either of the following

        1) Analog Output, Voltage Mode, 0 – 10 VDC
        2) Analog Output, current Mode, 4 – 20 mA

    d. Binary Outputs - shall output the following:

        1) 24 VAC Triac

    e. Configurable Outputs - shall be capable of the following:

        1) Analog Output, Voltage Mode, 0 – 10 VDC
        2) Binary Output Mode, 24 VAC Trial

9. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).

    a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
    b. The FC Bus shall support communications between the FECs and the NAE.
    c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE.
    d. The FC Bus shall support a minimum of 100 IOMs and FEC in any combination.
    e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.

10. FEC shall be available in a 10 point version (2 UI, 1 BI, 3 BO, 4 CO) and a 17 point version (6 UI, 2 BI, 3 BO, 2 AO, 4 CO). FEC shall be able to expand I/O point capacity via the addition of Input/Output Modules.
11. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

    a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
    b. The SA Bus shall support a minimum of 10 devices per trunk.

c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.

12. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
13. The FEC shall support, but not be limited to, the following:

    a. Steam central plant applications
    b. Special programs as required for systems control

14. The Controls Contractor shall provide FECs with unused Input/Output Module (IOM) capacity such that IOMs can be added to any existing FEC to achieve additional point capacity of 15% for each type of point (AI, BI, AO, BO, PI) currently part of the FEC input/output configuration. NO EXCEPTIONS. Additional IOM capacity shall be detailed for each FEC as part of the submittals:

B. Input/Output Module

1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the associated FEC.
2. The IOM shall communicate with the FEC over the SA Bus using BACnet Standard protocol SSPC-135, Clause 9.
3. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
4. The IOM shall be available in 4 point (4 BI), 6 point (2 UI, 2UO, 2 RO), 12 point (4 UI, 4 UO, 4 RO) and 17 point (6 UI, 2 BI, 2 AO, 3 BO, 4 CO) versions.
5. The IOM shall support the following types of inputs and outputs:

    a. Universal Inputs - shall be configured to monitor any of the following:

        1) Analog Input, Voltage Mode, 0-10 VDC
        2) Analog Input, Current Mode, 4-20 mA
        3) Analog Input, Resistive Mode
        4) Binary Input, Dry Contact Maintained Mode

    b. Binary Inputs - shall be configured to monitor either of the following:

        1) Dry Contact Maintained Mode
        2) Pulse Counter Mode

    c. Analog Outputs - shall be configured to output either of the following

        1) Analog Output, Voltage Mode, 0-10 VDC
        2) Analog Output, current Mode, 4-20 mA

    d. Binary Outputs - shall output the following:

        1) 24 VAC Triac

    e. Universal Output - shall be configured to output any of the following

        1) Analog Output, Voltage Mode, 0-10 VDC
        2) Analog Output, current Mode, 4-20 mA
        3) Binary Output Mode, 24 V AC/DC FET

f. Relay Output – 120/240 VAC
g. Configurable Outputs - shall be capable of the following:

1) Analog Output, Voltage Mode, 0-10 VDC
2) Binary Output Mode, 24 VAC Triac

6. The IOM shall include troubleshooting LED indicators to identify the following conditions:

a. Power On
b. Power Off
c. Download or Startup in progress, not ready for normal operation
d. No Faults
e. Device Fault
f. Normal Data Transmission
g. No Data Transmission
h. No Communication

2.8 OPERATOR TOOLS

A. A Graphical Programmer's utility tool shall be provided. The GP is a tool that provides an intuitive interface for programming, compiling and downloading control applications to BACnet controllers. An application shall represent all of the control logic in a controller. All BACnet controllers shall be programmed using the GP. The utility shall be capable of downloading application programs to all of the devices within the control system.

2.9 INPUT DEVICES

A. General Requirements

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.
2. Hardware safeties shall be auto reset type. Controller software shall include provisions to automatically restart equipment after alarm condition clears. In addition, controller software shall lock-out auto restart capability after a safety trips 3 (adj.) times in a 12 hour period. Auto restart capability lock-out shall be alarmed at the central operator workstation as well as text messaged to designated Client Agency personnel.
3. Hardware safeties shall be hardwired to their associated starter, VFD, etc. The hardware terminal device shall include an auxiliary set of contacts for input of alarm condition to the DDC system. Hardware safety alarm trips shall be alarmed at the central operator workstation as well as text messaged to designated Client Agency personnel.

B. Liquid-Pressure Transmitters

1. Liquid-Pressure Differential Transmitter:

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) Dwyer Instruments, Inc.
2) Or equal as approved by the Professional

b. Performance

1) Range: Approximately 2 times setpoint
2) Span: Adjustable plus or minus one milliamp, noninteractive

3) Accuracy: Within 0.25 percent of full scale
4) Pressure: Maximum operating pressure 2.5 times range
5) Temperature Limits: 0 to 150 deg F
6) Compensate Temperature Limits: 30 to 150 deg F
7) Thermal Effects: 0.02 percent of full scale per degree F
8) Response Time: 30 to 50 ms
9) Shock and vibration shall not harm the transmitter

c. Analog Output Current Signal

1) Two-wire 4-20 mA DC current source
2) Signal capable of operating into 1000 ohm load

d. Operator Interface

1) Zero and space adjustments located behind cover
2) Bleed screws on side of body, two screws on low-pressure side, and one screw on high-pressure side, for air in line and pressure cavity

e. Construction

1) Aluminum and stainless-steel enclosure with removable cover
2) Wetted parts of transmitter constructed of 17-4 PH or 300 Series stainless steel
3) Threaded, NPS 1/4 process connections on side of instrument enclosure
4) Knock out for 1/2 inch nominal conduit connection on side of instrument enclosure
5) Screw terminal block for wire connections
6) NEMA 250, Type 4X

f. Three-valve manifold. Construct manifold of brass, bronze, or stainless steel. Manifold shall have threaded, NPS 1/4 process connections

C. Liquid and Steam Temperature Transmitters, Commercial Grade

1. House electronics in NEMA 250, Type 4, or Type 4X enclosure
2. Enclosure Connection: 1/2 inch trade size
3. Functional Characteristics:

a. Input: 100 ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two or three wire sensors.
b. Default Span (adj.)

1) Condenser Water: 0 to 120 deg F

c. Output: 4-20 mA DC, linear with temperature; RFI insensitive; minimum drive load of 600 ohm at 24V DC
d. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F
e. Match sensor with temperature transmitter and factory calibrate together. Each matched sensor and transmitter set shall include factory calibration data traceable to NIST.

4. Performance Characteristics

a. Calibration Accuracy: Within 0.1 percent of the span

b. Stability: Within 0.2 percent of the span for at least 6 months
c. Combined Accuracy: Within 0.5 percent

5. Thermowells

a. Stem: Straight or stepped shank formed from solid bar stock
b. Material: Brass or stainless steel
c. Process Connection: Threaded, NPS 3/4
d. Sensor Connection: Threaded, NPS 1/2
e. Bore: Sized to accommodate sensor with tight tolerance between sensor and well
f. Furnish thermowells installed in insulation pipes and equipment with an extended neck
g. Length: 4, 6, or 8 inches as required by application
h. Thermowells furnished with heat-transfer compound to eliminate air gap between wall of sensor and thermowell and to reduce time constant

D. Boiler Plant Flow Meters (Steam, Natural Gas, Oil, Feedwater)

1. Provide an ONICON Model F-5100 Insertion Thermal Mass Flow Meter, or equal as approved by the Professional, for natural gas flow, complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand-insertable up to 250 psi. Materials of construction for wetted metal components shall be 316 SS. The flow meter shall provide SFPM flow readings from a pair of encapsulated platinum sensors and shall not require additional temperature or pressure compensation. In addition, the meter shall continuously display information that can be used to validate the calibration of the meter. Each flow meter shall be individually wet-calibrated against a standard that is directly traceable to NIST*. A certificate of calibration shall be provided with each flow meter.

a. Fluid Temperature: -40 deg F to 200 deg F
b. Maximum Operating Pressure: 500 psi

2. Provide Onicon Series 3000 Inline Electromagnetic Flow meter for Feedwater flow.

a. Fluid Temperature (Liner Based):
Ebonite – 32 deg F to 175 deg F
Polypropylene – 32 deg F to 140 deg F
PTFE – 0 deg F to 266 deg F
b. Maximum Operating Pressure (Liner Based):
Ebonite – 580 psi
Polypropylene – 232 psi
PTFE – 580 psi

3. Provide Series 2000 Inline Vortex Flow meter for boiler steam flow.

a. Fluid Temperature:
Standard – -40 deg C to 260 deg C
High Temperature – -40 deg C to 400 deg C

4. Provide a Dwyer positive displacement fuel oil meter for boiler fuel oil flow.

5. Accuracy shall be within ± 1% of rate from 500-7000 SFPM and ± 2% of rate from 100-500 SFPM. Overall turndown shall exceed 1000:1. Output signals shall consist of the following: (1) analog 4-20mA output and (1) scalable pulse output for totalization. The meter shall be equipped with an integrally mounted graphical display that may be optionally remote mounted up to 1000 ft from the sensor. Each flow meter shall be covered by the

manufacturer's one-year warranty.

6. Provide a D-100 Series Display Module for local or remote indication of flow rate and total. Output signals shall be either serial network (protocol conforming to BACnet® MS/TP, BACnet/IP, LONWORKS®, MODBUS RTU RS485, MODBUS RTU TCP, JCI-N2, or Siemens-P1) or via individual analog and pulse outputs.

E. Status Switches

1. General Requirements

a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the control system when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

2. Current Sensing Switches

a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range
b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
d. Acceptable manufacturers: Veris Industries

2.10 OUTPUT DEVICES

A. Actuators

1. General Requirements

a. Valve actuators shall be electronic.

2. Electronic Actuators

a. Modulating and two-position actuators shall be provided as required by the sequence of operations. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the valves, as required. All actuators shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction and a gear release to allow manual positioning.
b. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication.
c. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds.
d. Acceptable manufacturers: Johnson Controls, Schneider Electric.

B. Control Relays

1. Control Pilot Relays

a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
b. Mounting Bases shall be snap-mount.
c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
d. Contacts shall be rated for 10 amps at 120VAC.
e. Relays shall have an integral indicator light and check button.
f. Acceptable manufacturers: Johnson Controls, Potter and Brumfield

2.11 STANDBY POWER

A. The system shall be provided with sufficient standby power to operate the workstation/controller upon loss of normal AC power in a normal mode for a period of 15 minutes. The incoming normal power to the workstation/controller shall be monitored so that any power failure will be indicated at the workstation/controller. The system shall automatically transfer to battery standby upon AC power failure. All battery charging and recharging operations shall be automatic. The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be alarmed. Workstations/controllers shall be provided with UPS panels as indicated on the control drawings

B. UPS power supplies shall condition and maintain clean power to each BACnet control panel noted. This shall include surge protection and filtering.

C. UPS power supplies shall also include LED status display for:

1. On line power.
2. On battery power.
3. Replace Battery
4. Audible alarm when on battery
5. Distinctive low battery alarm.

2.12 VARIABLE FREQUENCY DRIVES

A. Variable frequency drives shall be provided by the HVAC Sub-Contractor. The BMS Sub-Contractor shall control and communicate with the VFDs as further defined below.

B. Serial Communication:

1. The VFD shall have a BACnet port as standard. Each individual drive shall have the selected protocol factory installed in the base VFD. The use of third-party gateways and multiplexers is not acceptable. All protocols shall be “certified” by the governing authority. Use of non-certified protocols is not allowed.
2. It will be the responsibility of each drive manufacturer to ensure that the correct Serial Communication for this Project has been selected and installed in each drive at the manufacturer’s factory.
3. The BACnet connection shall be an RS485, MSTP interface. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed.
4. If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFDs sharing one gateway shall not be acceptable.
5. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, PID control adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating

hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The DDC system shall also be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.

C. VFD Control

1. The VFD shall allow the control system to control the drive’s digital and analog outputs via the serial interface. This control shall be independent of any VFD function. However, for this project, the drives shall be monitored through the Serial Communication but additionally incorporate a hard-wired analog input for speed control of the drives and a binary input for the Starting and Stopping of the drives.

2.13 MISCELLANEOUS DEVICES

A. Local Control Panels

1. All control panels shall be factory constructed, incorporating the BMS manufacturer’s standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
2. In general, the control panels shall consist of the DDC controller(s), display module as specified and/or indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where a display module is specified, the display module shall be flush mounted in the panel face unless otherwise noted.
3. All panel wiring shall be to and from terminal strips. The use of wire nuts for connection of wiring to or from a common point is not acceptable.
4. All I/O connections on the DDC controller shall be provided via removable or fixed screw terminals.
5. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
6. All wiring shall be neatly installed in plastic trays.
7. All wiring shall be identified.
8. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

B. Power Supplies

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

C. 277 VAC to 24 VAC Power Boxes

1. Furnish and install UL listed, Class 2, UL916 power boxes. Power Boxes shall accept 277 VAC input and provide 24 VAC output. Furnish and install power boxes as required to satisfy connected load requirements. Power boxes shall be NEMA 1 rated enclosure and contain one or multiple outputs. Each 24 VAC output shall contain a combination on/off switch and circuit breaker. Each output shall be an isolated 24VAC 75 or 100 VA output with a red LED for output voltage indication.

PART 3 – PERFORMANCE / EXECUTION

3.1 CONTROL SYTEMS SPECIFIC REQUIREMENTS

A. Graphic Displays

1. Provide a colorgraphic system flow diagram display for each system with all points as indicated on the point list.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.
3. All setpoints, parameters, etc. designated as manually adjustable (i.e. adj.) in the sequences of operation shall be directly adjustable from the associated colorgraphic screen or a separate setpoint screen, the latter being directly accessible via a transfer point on the original colorgraphic screen. It shall not be necessary to leave the colorgraphic screen package in order to make the adjustments. NO EXCEPTIONS. Setpoint adjustment shall be a single step process (i.e. not require multiple save operations) and all setpoint changes shall be retained during power outages. Any deviation from these requirements shall be clearly pointed out in the control system Architecture Overview submission that accompanies the bid.
4. Alarm limit, setpoint and reset schedule values indicated in the specifications or sequences of operation are given as starting points only. Final values shall be established during the commissioning process and provided in hard copy documented format by the Controls Contractor as part of the O & M manual submission at project completion.
5. Colorgraphics package shall incorporate a “Manual Bypass” feature for the automatic load reduction functions. The operator shall be able to “toggle” a single point from a colorgraphic screen to enable or disable automatic load reduction sequencing. Colorgraphics package shall also incorporate a “Manual Curtailment Initiate” feature for manual load reduction functions. The operator shall be able to “toggle” a single point from a colorgraphic screen to enable load reduction sequencing described above.

B. The following graphical screens, as a minimum, shall be developed for this project. For each system or floor plan, the display shall contain the points identified in the point list (or available via the interface) as well as associated software points and allow for setpoint changes, overrides etc. Where necessary, multiple graphic screens shall be provided for a unit/system in order to convey the required information in an uncluttered fashion. Sequence of operation information, shop drawings and specification data sheets associated with a system shall be available from the colorgraphic screen associated with that system. This feature shall be fully implemented for all colorgraphic screens created for this project.

Main Screen
Steam Boiler System
Steam Boiler System Setpoints
Fuel Oil System
Miscellaneous

C. Custom Reports:

1. Provide custom reports as required for this project:

D. Actuation / Control Type

1. Primary Equipment

a. All valve actuation shall be electric.

E. The Controls Contractor shall meet with the Client Agency to determine routine requirements for all alarm information. Particular attention shall be paid to developing a routine procedure that prevents non-critical alarms from impacting critical system operation. The prioritization and routine shall be fully implemented to the satisfaction of the Client Agency.

3.2 INSTALLATION PRACTICES

A. Control Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the control system, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
2. All conduit, fittings, hangers and accessories for control wiring installed under the HVAC Contract shall conform to the levels of quality specified under Division 26.
3. All wiring shall be installed in conduit, and conduit shall be concealed in finished areas, except as hereinafter specified. Power or interlock wiring shall be run in separate conduit from sensor wiring.
4. All low voltage conductors shall be types as herein indicated. Other types and sizes required by the temperature control manufacturer shall be submitted for approval. Low voltage two conductor wire shall be black twisted (six turns per foot) 16 AWG or 18 AWG wire, as indicated, 1/32, 80 degrees C., 600 volt PVC insulation. Low voltage three conductor wire shall be red, yellow, blue twisted (six turns per foot) 16 AWG or 18 AWG wire as indicated, 1/32, 80 degrees C., 600 volt PVC insulation. Cable shall be as manufactured by Alpha Wire Company, Belden Wire Company, Standard Wire and Cable or approved equal.
5. All control wiring outside of control panels shall be run in rigid conduit or EMT, except as hereinafter specified, and installed in strict accordance with the requirements of The National Electrical Code. Wiring for the control system, except the low voltage conductors, shall be single conductor solid or stranded copper not less than No. 14 AWG, with 600 volt Type THHN insulation, except where the manufacturer requires special types and sizes. Flameproof insulation shall be used where required by the NEC. Wiring for DDC system inputs/outputs shall be No. 18 two conductor with shield installed in accordance with the requirements of The National Electrical Code. Wiring for DDC system communication trunk shall be 2 conductor, 24AWG, stranded shielded low capacitance cable. All wiring in panel construction may be No. 16 or No. 18 AWG copper as recommended by the manufacturer provided same is properly protected and/or is in accordance with the NEC. No temperature control wiring installed under this contract shall be installed in the building lighting and power circuit systems. Communication trunk wiring shall not be installed in raceway and/or enclosures containing Class 1 or other Class 2 wiring.
6. The use of plenum rated cable shall be permitted in cable trays. The ATC Contractor shall be permitted to use cable trays being installed under the electrical contract if the electrical contractor determines that sufficient space is available and grants permission. The ATC Contractor shall be responsible for determining that no electrical interference will occur, to either control or electrical systems, as a result of such a tray sharing arrangement.

B. All sensing elements located in water lines or tanks shall be provided with stainless steel separable sockets. The BMS Contractor shall select the proper location for each separable well and shall provide written installation directions to the mechanical contractor for installation. Sensing elements installed in ducts shall be securely anchored, and when long or averaging sensing elements are used the elements shall be strung through the duct to ensure representative cross sectional sampling

C. All control system controllers, panels and input/output interface panels shall be identified with black laminated plastic nameplates with white lettering. All control system controllers shall also have black laminated plastic tags with white lettering identifying controller IP address. Controller panel identification shall be the same as used on the control drawings such that it can be easily cross referenced with as-built drawings, and shall also include system, area served, etc.. All items of equipment within input/output interface panels shall be labeled with an identification that also corresponds with as-built drawings. All items mounted on the face of input/output interface panels shall be identified with black laminated plastic nameplates with white lettering. Identification shall include function and position information where applicable. All field devices shall be identified with black laminated plastic nameplates with white lettering secured with either double-backed tape or metallic strapping. Identification shall be same tag symbol as found on the as-built drawings and shall also include system, area served, etc. In addition, control devices shall also include range data (as applicable) and signal type (4-20 mA, Open/Closed, etc.) information.

3.3 START-UP AND CHECK-OUT PROCEDURES

A. The ATC Contractor shall be responsible for developing test plans and procedures to establish that the control system functions as described in the Sequence of Operations. The methodology shall address the observations, measurements, adjustments, calibrations and corrections necessary to accomplish the commissioning process. A detailed item-by-item procedure shall be followed for each item of HVAC equipment. Forms used by the ATC Contractor to record the results of the start-up and check-out procedures shall be available for review by the Professional and the Client Agency.

B. The procedures followed shall, as a minimum, incorporate the requirements of Section 230800 Mechanical Systems Commissioning.

C. Where Maintenance Time Reminders, Change-of-State Alarms, Analog Limit Alarms, etc. are to be provided, the ATC Contractor shall verify that each message is sent to the appropriate output device whenever the trigger condition occurs.

D. Where colorgraphics are being provided, the ATC Contractor shall verify that all links from dynamic point displays to the actual hardware and software points are correct. This verification shall involve using each colorgraphic screen to make all setpoint changes, schedule overrides, control overrides etc. and verify that the appropriate changes to the control hardware and panel databases take place.

E. Where implemented trends at the panel level and/or the HMI computer level are to be provided, the ATC Contractor shall demonstrate successful implementation via actual printout of the data being gathered in the case of panel trends, and display, archiving and printout of trend data being gathered at the HMI level.

3.4 COMMISSIONING

A. As part of the work of this project, the BMS Sub-Contractor shall be responsible for providing all labor and materials required to satisfy the commissioning responsibilities of the BMS Sub-Contractor in support of the work of the Professional. It shall be the responsibility of the Professional to verify fully functioning BMS system.

B. All points connected to the control system shall operate fully in accordance with this specification before final completion is determined.

C. Equipment Start-up: Upon completion of installation, all equipment being controlled shall be initially started and tested on site, using a portable operator interface connected to individual controllers.

1. Verify that all inputs are properly being read.
2. Measure, calibrate, and adjust all analog inputs.
3. Stroke all analog outputs from 0% to 100% and verify all linkage adjustments are accurate.
4. Valves shall fully close and provide tight shut-off with no leakage.
5. Verify all digital outputs are properly energizing the controlled device.
6. Adjust setpoints so equipment can run properly. Temporary setpoints and schedules are acceptable for this phase.
7. Communication Network Start-up: Verify from a host computer that all of the controllers are being addressed from the host. Verify communication speed is acceptable and meets the requirements of this specification.

D. Software Verification: All programs and software functions shall be verified for proper sequence of operation.

3.5 TRAINING

A. ATC Contractor shall provide 120 Hours of on-site training, broken down into 4-hour sessions, by a system technician who is fully knowledgeable of the specific installation details of the project. This training shall be "hands' on" type. A mutual agreement on the scheduling of this training class will be made between the Client Agency and the ATC Contractor. The intent of this training is that 60 hours will occur before the Client Agency has accepted the project and the rest is to follow shortly thereafter. It will not be necessary to videotape on-site training.

B. The training class will use the actual Operator & Maintenance manual that will be submitted for this project.

C. As a minimum, this training will cover the following topics:

1. System Overview

a. Architecture and Function

2. System Operation

a. System Access
b. Operation Monitoring
c. Exception Reporting and Acknowledge
d. Operation Override
e. Scheduling
f. Editing Programmed Variables

D. The training class will cover topics in a "hands-on" mode.

E. Proper and adequate documentation must be provided, this will include:

1. Accurate as-built drawings and sequences submitted in hard copy and electronic form (the electronic form can be easily updated via a standard Computer Aided Drafted (CAD) program).

2. Technical specification sheets
3. Signed software license agreement (as required)
4. Operator & Maintenance (O & M) manuals
5. Warranty statement

F. Additional Training

1. In addition to the on-site training, the Controls Contractor shall include a $10,000 allowance for off-site factory training to be used at the Client Agency's discretion. The $10,000 allowance shall not include any travel, lodging or meals.

3.6 WARRANTY

A. The local field office shall warranty all control system computers and related I/O equipment and all new pneumatic and electric hardware for a period of one year following Client Agency acceptance of the system.

B. All equipment found to have defects in material or workmanship during this warranty period shall be replaced at no charge to the Client Agency with equipment of equal type and quality by the control system manufacturer. All labor required during the warranty period shall also be included, with the following clarification. Materials furnished but not installed by the Controls contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation.

C. Operator workstation software, project-specific software, graphic software (where specified), database software, and firmware updates which resolve known software deficiencies as identified by the BMS Contractor shall be provided to the Client Agency at no charge during the warranty period.

D. The BMS Contractor shall respond to the job site within a 24 hour period for any warranty work relating to the control system.

3.7 WARRANTY ACCESS

A. The Client Agency shall grant to the Contractor, reasonable access to the control system during the warranty period. The Client Agency shall provide, at no cost to the Contractor, a public IP address for the Workstation Server Hardware Station for remote telecommunication during this period.

B. Internet connection shall provide the following functions:

1. Access to the entire facility control system by the Contractor to provide service and diagnostic support.
2. Access by the Client Agency from off-site for similar purposes, and for remote operation, monitoring, and adjustment of facility functions.
3. Complete remote access to all programming tools
4. Auto email notification of desired alarms to a remote site.

3.8 APPLICATION DEVELOPMENT AND REVIEW

A. The control drawings and the sequences of operation are for conveying general concept only and are not meant to be inclusive of all hardware requirements or all functional sequence requirements. Refer to the complete package of contract drawings for equipment quantity and location information. Items mentioned in Sections 23 0900 and 23 0993, shown on the control drawings, mentioned in the sequences of operation or shown on other HVAC drawings shall become part of the work of this project without the necessity of being separately detailed in each

of those applicable sections of the contract documents. Reference in one section of the contract documents shall be interpreted to include reference in all other applicable sections. Any additional hardware and/or software required to accomplish functional intent shall be provided (without additional cost to the Client Agency) just as though it were fully detailed on the contract documents.

B. The BMS Sub-Contractor shall be responsible for providing complete detailed sequences of operation for each piece of equipment or system regardless of the completeness and clarity of the sequences in the contract documents. These detailed sequences shall address all operating modes including, but not limited to, normal, failure, failure recovery. These detailed sequences shall also address all system interaction and operational interfaces and shall be required prior to beginning implementation of the application software and MMI package. The sequences of operation as written infer certain additional functionality in order to accomplish project intent. With that in mind, software review meetings shall be held with the Professional, Client Agency, and BMS Sub-Contractor to finalize details prior to beginning implementation of the application software and MMI package and again at regular intervals during initial operation of the system. Professional and/or BMS Sub-Contractor shall coordinate scheduling and recording keeping. Following is a summary of anticipated review meetings and required follow-up actions by the BMS Contractor.

1. Review scope of software to be implemented. This shall be an interchange of ideas and operating characteristics of the equipment and facility. All data relative to system operations and design criteria shall be presented at this time. The BMS Contractor shall gather this data and structure the required software around this information. This shall occur prior to starting any software programming by the control installer. This meeting shall also establish the system and point naming conventions to be used throughout the project by the BMS Contractor. Naming conventions shall be approved by the Professional and the Client Agency. Colorgraphic screens hierarchy, layout, functionality and operator interaction, including alarming and trending, shall be presented for approval by the Professional and the Client Agency.
2. After one (1) to three (3) months of heating season operation, as deemed appropriate by any party, an operations/software review shall be held. Any changes required shall be implemented by the BMS Sub-Contractor after this meeting at no additional cost to the Client Agency.
3. Prior to the beginning of the next heating season, a final heating season software review shall be held to review the operational sequences, resolve any issues that may have occurred and/or implement desired software changes to enhance the system operation.
4. Final software reviews shall be held for each system to review the operational sequences, resolve any issues that may have occurred and/or implement desired software changes to enhance the system operation.
5. All points picked up by the Master Control Panel and relayed to the panels, data acquisition system, and operator PC must be field verified by the vendor as part of the commissioning of the new boiler plant system before turning it over to the facility as a fully operation system.

END OF SECTION 23 0900

SECTION 23 0993 – SEQUENCES OF OPERATION FOR HVAC CONTROLS

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS, REQUIRED COORDINATION/CLARIFICATIONS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. All work of this Section shall be coordinated and provided by the single Boiler Management System (BMS) Sub-Contractor.

1. Throughout these specifications, any reference to “BMS Sub-Contractor”, "ATC Sub-Contractor", "BAS Control Sub-Contractor", "Controls Sub-Contractor" or “local field office” shall be interpreted as referring to the Boiler Management System (BMS) Sub-Contractor who shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Boiler Management Systems as further defined for this project by Sections 230900 and 230993 of these contract documents.

C. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.

D. The work of this Section shall be as required by the Specifications, Drawings, Point Schedules, Sequences of Operation and Mechanical Systems Commissioning activities.

E. The contract documents and the sequences of operation are for conveying general concept only and are not meant to be inclusive of all hardware requirements or all functional sequence requirements. Refer to the complete package of contract drawings. Items mentioned in Sections 230900 and 230993, shown on the contract documents, or mentioned in the sequences of operation shall become part of the work of this project without the necessity of being separately detailed in each of those applicable sections of the contract documents. Reference in one section of the contract documents shall be interpreted to include reference in all other applicable sections. Any additional hardware and/or software required to accomplish functional intent shall be provided (without additional cost to the Client Agency) just as though it were fully detailed throughout the contract documents.

PART 2 – PRODUCTS

2.1 NOT APPLICABLE TO THIS SECTION

PART 3 – SEQUENCES OF OPERATION

3.1 COMMUNICATION INTERFACES

A. The mechanical or electrical equipment supplier shall provide all required on site time to coordinate, checkout and confirm BMS communication interface operation to the satisfaction of the project BMS Sub-Contractor. On site visits shall be scheduled by the BMS Sub-Contractor

through the mechanical or electrical Sub-Contractor as appropriate for the equipment being interfaced to.

B. The mechanical or electrical equipment supplier shall also provide all required on site time to coordinate, checkout and confirm BMS communication interface operation to the satisfaction of the project Commissioning Agent. On site visits shall be scheduled by the Commissioning Agent through the mechanical or electrical Sub-Contractor as appropriate for the equipment being interfaced to.

3.2 SPECIAL SEQUENCE REQUIREMENTS

A. Upon a loss of power, the boiler control system shall reset all systems as required to begin an organized time delayed (adj.) mechanical system restart. Portions of the boiler control system are on emergency power (boiler control panel) and will be able to retain status information for the equipment. The BMS Sub-Contractor shall provide a battery back-up power supply for this panel to maintain operation between normal and emergency power.

B. All setpoints, parameters, etc. designated as manually adjustable (i.e. adj.) in the sequences of operation shall be directly adjustable from the colorgraphics. The associated colorgraphic screen or a separate setpoint screen, the latter being directly accessible via a transfer point on the original colorgraphic screen or from a tree structure, shall provide for the adjustment function. It shall not be necessary to leave the colorgraphic screen package in order to make the adjustments. NO EXCEPTIONS

C. The BMS Sub-Contractor shall provide all wiring, point mapping, programming, check out and verification by providing a BACnet interface to EACH price of equipment listed with BACnet communication, provided under the Mechanical Contract. Each piece of equipment shall be provided with BACnet interface card by the manufacture supplier. Coordinate BACnet interface type with that supplier. Where AO, AI, BO and/or BI points are listed in the points lists, these points shall be hardwired DDC system I/O points and NOT COMMUNICATED POINTS – NO EXCEPTIONS.

D. The BMS Sub-Contractor shall meet with the Client Agency to determine routine requirements for all alarm information. Particular attention shall be paid to developing a routine procedure that prevents non-critical alarms from impacting critical system operation. The prioritization and routing shall be fully implemented to the satisfaction of the Client Agency.

E. The following applications software shall be provided fully implemented, where applicable, for the HVAC equipment configuration for the purpose of optimizing energy consumption while maintaining occupant comfort:

1. Time of Day Scheduling (TOD) The system shall be capable of the following scheduling features:

    a. Schedule by Type: Scheduling by building, area, zone, groups of zones, individually controlled equipment and groups of individually controlled equipment.
    b. Schedule in Advance: Dated schedules shall be entered in advance.
    c. Self-Deleting: Schedules shall be self-deleting when effective dates have passed.
    d. Leap Year: Leap years shall be adjusted automatically without operator intervention.

F. Alarms

* DENOTES MAINTENANCE TIME REMINDER (MTR)
~ DENOTES CHANGE OF STATE OR ANALOG LIMIT ALARM (and RETURN TO NORMAL)
All MTR, COS, LIMIT and RTN ALARM information designated in the following I/O points lists shall also be fully implemented as part of the work of this project.

3.3 COLORGRAPHICS

A. Refer to Section 23 0900, paragraph 3.1 C., for colorgraphic screen requirements.

3.4 STEAM BOILER PLANT

A. Boiler System Operation

1. The boiler system shall be energized under most conditions. The boiler system shall maintain steam pressure in the header within the range of 70 to 80 psig (adj.) in the winter operation and within the range of 35 to 45 psig (adj.) in the summer operation.

2. The boiler control system shall be programmed with automatic lead/lag/standby changeover control. Boiler control system shall have the ability to operate in hand for manual control by the user.

3. The boiler system consists of five (5) boilers. In the summer mode of operation, only boiler B-6 shall be enabled to operate. In the winter mode of operation, boilers B-2 thru B-5 shall be enabled to operate. One boiler shall serve as the lead boiler, one boiler shall serve as the lag boiler, and two boilers shall serve as the standby boilers. The boiler controls shall cycle the lag and standby boilers (as required) to maintain the lag and standby boilers at 320 deg F (adj.) to minimize the time to reach operating pressure.

4. The Master Boiler Control Panel shall alternate the lead, lag, and standby boilers every 30 days (adj.).

5. The lead boiler burner shall maintain steam header pressure at between 75 and 78 psig (adj.) in the winter operation and between 40 and 43 psig (adj.) in the summer operation. The boiler shall fire, via its own linkageless control system, when steam pressure falls below minimum setpoint, shall modulate firing as steam pressure rises, and shall cease firing when steam pressure rises to maximum setpoint.

6. The lag boiler burner shall fire when the lead boiler firing rate exceeds 75% (adj.) and both boilers shall modulate in unison. When firing rates of both boilers drops to 25%, the lag boiler shall cease firing.

7. If steam header pressure drops below minimum operating range (70 psig (adj.) in the winter operation and within the range of 35 psig (adj.) in the summer operation) the Master Boiler Control Panel shall send an alarm and begin firing the standby boiler.

8. The boiler burners shall modulate firing rate, via their own controls, as needed to maintain steam pressure. Each boiler shall fire at low fire and increase its firing rate as needed to maintain steam pressure. As the steam header pressure increases toward its high setpoint, the boiler burner shall modulate toward low fire.

9. Each boiler shall modulate its boiler feedwater valve, to match its firing rate and to maintain water level in its boiler.

10. The Master Boiler Control Panel shall show all boiler operating parameters and alarms over the Boiler Management System (BMS).

11. Manual intervention by an operator will be required when power is restored either through a backup power source or through normal power, if restored before backup power is brough online, for boiler restart.

B. Deaerator Feedwater Pump Operation

1. The system consists of two deaerators (Existing DA-1 and DA-2) with their own dedicated feedwater pumps and condensate transfer pumps (where applicable). DA-2 is equipped with a surge tank.

   a. Existing DA-1 has four (4) feedwater pumps (operating in lead/lag/standby rotation) and no condensate transfer pumps.
   b. DA-2 has three (3) feedwater pumps (operating in lead/lag/standby rotation) and two (2) condensate transfer pumps, operating in lead/lag rotation.

2. DA-2 shall be always be enabled and operate to provide feedwater to the boilers. Existing DA-1 shall be manually enabled as a backup only.

3. The feedwater pumps and condensate transfer pumps (where applicable) shall operate as needed, via a signal from the Master Boiler Control Panel. Feedwater pumps shall maintain to maintain water pressure as sensed at a pressure transducer in the common feedwater header of the feedwater piping system.

4. The Master Boiler Control Panel shall alternate the lead/lag/standby feedwater pumps and condensate transfer pumps (where applicable) on a runtime schedule (adj.).

5. The feedwater pump shall energize a minimum of 10 seconds (adj.) prior to the boiler firing. An additional feedwater pump shall energize when an additional boiler fires.

6. If feedwater pressure drops below the minimum pressure setpoint (adj.) after an adjustable time delay, the lag pump shall be energized. If pressure goes above an adjustable pressure setpoint, the lag pump shall be de-energized.

7. Pump current switches shall feedback pump operation.

C. Steam Meters

1. The steam meters shall report steam pounds per hour and totalized usage via the Boiler Control panels, Master Boiler Control panel, and the boiler control system.

D. Gas Meters

1. The gas meters shall report mass flow rate and totalized usage via the Boiler Control panels, Master Boiler Control panel, and the boiler control system.

E. Fuel Oil Meters

1. The fuel oil meters shall report mass flow rate and totalized usage via the Boiler Control panels, Master Boiler Control panel, and the boiler control system.

F. Water Meters (Make-up)

1. The water meters installed by the 0.2 Contractor, shall report GPM and totalized usage via the Boiler Control panels, Master Boiler Control panel, and the boiler control system.

G. Blowdown and Chemical Feed

1. The blowdown monitoring and chemical feed controller shall operate automatic surface blowdown based on usage and water quality. Automatic blowdown valves shall open for a predetermined (adjustable) number of seconds then close. Boilers shall blowdown one at

a time so not all boilers are blowing down simultaneously.

2. Water temperature at the blowdown separator shall operate per its own self-contained temperature sensor and tempering valve to maintain discharge temperature to the sanitary sewer system at or below 140 deg F. Water tempering shall be locally adjustable.

3. The blowdown monitoring and chemical feed controller shall measure average conductivity of the conductivity sensors on the automatic blowdown system and energize the amine chemical treatment pump to conductivity levels within the specified range.

4. The blowdown monitoring and chemical feed controller shall monitor make-up water quantity as measured at the make-up water meter and energize the sulfite and polymer caustic chemical treatment pumps at the rate needed to maintain water quality within the specified range.

H. Trending

1. The BMS system shall be capable of monitoring and trending the following items every minute for a period of two (2) years:

   a. Boiler water level
   b. Feedwater valve position
   c. Steam pressure at the steam header
   d. Makeup water flow rate
   e. Steam lbs/hr per boiler and total
   f. Stack temperature
   g. Stack oxygen
   h. The operational status of each boiler and its firing rate
   i. Burner damper position
   j. Burner fan speed
   k. Natural gas flow per boiler and total
   l. Natural gas control valve position
   m. Natural gas operating hours
   n. Fuel oil flow per boiler and total
   o. Fuel oil control valve position
   p. Fuel oil operating hours
   q. Steam volume and velocity at each steam meter
   r. Operational status of the water treatment controller
   s. FW pump pressure and temperature
   t. FW pump ON/OFF/STBY status
   u. FW pump operating hours

I. Safeties and Alarms

1. If a piece of equipment (boiler, pump, etc.) which is commanded on and fails to operate, an alarm shall be issued, the standby equipment shall be energized, and the failed piece of equipment shall be de-energized and locked-out.

2. If a fault signal from a VFD is received, an alarm shall be issued, the standby equipment shall be energized, and the faulted pump or fan shall be de-energized and locked-out.

J. Plant Master Controller Interface

1. All Boiler Plant monitoring and control components and devices are furnished by the boiler plant equipment supplier. All field installed control and interlock wiring required for operation of the boiler systems shall be furnished and installed by the boiler plant

equipment supplier.

2. The BAS shall communicate with the following subsystems via a BACnet IP communication provided with the associated equipment.

   Boiler plant master controller
   Fuel oil transfer system

3. Communication Interface Points: In addition to the points listed below, BMS Sub-Contractor shall provide any other points that the Client Agency requests that are available via the various BACnet interfaces provided.

   GENERAL SYSTEM POINTS
   AV Gas Header Pressure
   AV Oil Header Pressure
   AV Boiler Plant Make-up Water Supply

   MAIN MAKE-UP WATER
   AV Make-up Water Main -- Water Usage
   AV Make-up Water Main -- Temperature

   BOILER B-2
   BV Boiler B-2 Start Command
   BV Boiler B-2 Status
   AV Boiler B-2 Steam Flow ~
   AV Boiler B-2 Gas Steam Total
   AV Boiler B-2 Oil Steam Total
   AV Boiler B-2 Gas Supply Flow
   AV Boiler B-2 Gas Total
   AV Boiler B-2 Fuel Oil Supply Flow
   AV Boiler B-2 Feedwater Total
   AV Boiler B-2 Drum Pressure
   AV Boiler B-2 Drum Level
   AV Boiler B-2 Boiler Feedwater Valve Position
   AV Boiler B-2 Water Conductivity
   AV Boiler B-2 Stack O2
   AV Boiler B-2 Stack Temperature
   AV Boiler B-2 Comb Air Temperature
   AV Boiler B-2 FD Fan Speed
   AV Boiler B-2 FD Fan Hz
   AV Boiler B-2 FD Fan Power
   AV Boiler B-2 FD Fan Electric Use
   AV Boiler B-2 Firing Rate
   AV Boiler B-2 Comb Eff
   AV Boiler B-2 Flame Signal
   AV Boiler B-2 Local Pressure Setpoint
   AV Boiler B-2 Steam Pressure - Actual
   BV Boiler B-2 Steam Pressure - HIGH Pressure -- ALARM
   BV Boiler B-2 Steam Pressure - LOW Pressure -- ALARM
   BV Boiler B-2 Local/Remote Status
   BV Boiler B-2 Auto/Manual Status
   BV Boiler B-2 Fuel Selected
   BV Boiler B-2 Fuel Valve Open
   AV Boiler B-2 Steam Flow to Feedwater Flow Ratio
   BV Boiler B-2 HIGH Water Level -- ALARM
   BV Boiler B-2 LOW Water Level -- ALARM

AV Boiler B-2 Temperature

BOILER B-3
BV Boiler B-3 Start Command
BV Boiler B-3 Status
AV Boiler B-3 Steam Flow ~
AV Boiler B-3 Gas Steam Total
AV Boiler B-3 Oil Steam Total
AV Boiler B-3 Gas Supply Flow
AV Boiler B-3 Gas Total
AV Boiler B-3 Fuel Oil Supply Flow
AV Boiler B-3 Feedwater Total
AV Boiler B-3 Drum Pressure
AV Boiler B-3 Drum Level
AV Boiler B-3 Boiler Feedwater Valve Position
AV Boiler B-3 Water Conductivity
AV Boiler B-3 Stack O2
AV Boiler B-3 Stack Temperature
AV Boiler B-3 Comb Air Temperature
AV Boiler B-3 FD Fan Speed
AV Boiler B-3 FD Fan Hz
AV Boiler B-3 FD Fan Power
AV Boiler B-3 FD Fan Electric Use
AV Boiler B-3 Firing Rate
AV Boiler B-3 Comb Eff
AV Boiler B-3 Flame Signal
AV Boiler B-3 Local Pressure Setpoint
AV Boiler B-3 Steam Pressure - Actual
BV Boiler B-3 Steam Pressure - HIGH Pressure -- ALARM
BV Boiler B-3 Steam Pressure - LOW Pressure -- ALARM
BV Boiler B-3 Local/Remote Status
BV Boiler B-3 Auto/Manual Status
BV Boiler B-3 Fuel Selected
BV Boiler B-3 Fuel Valve Open
AV Boiler B-3 Steam Flow to Feedwater Flow Ratio
BV Boiler B-3 HIGH Water Level -- ALARM
BV Boiler B-3 LOW Water Level -- ALARM
AV Boiler B-3 Temperature

BOILER B-4
BV Boiler B-4 Start Command
BV Boiler B-4 Status
AV Boiler B-4 Steam Flow ~
AV Boiler B-4 Gas Steam Total
AV Boiler B-4 Oil Steam Total
AV Boiler B-4 Gas Supply Flow
AV Boiler B-4 Gas Total
AV Boiler B-4 Fuel Oil Supply Flow
AV Boiler B-4 Feedwater Total
AV Boiler B-4 Drum Pressure
AV Boiler B-4 Drum Level
AV Boiler B-4 Boiler Feedwater Valve Position
AV Boiler B-4 Water Conductivity
AV Boiler B-4 Stack O2
AV Boiler B-4 Stack Temperature
AV Boiler B-4 Comb Air Temperature

AV Boiler B-4 FD Fan Speed
AV Boiler B-4 FD Fan Hz
AV Boiler B-4 FD Fan Power
AV Boiler B-4 FD Fan Electric Use
AV Boiler B-4 Firing Rate
AV Boiler B-4 Comb Eff
AV Boiler B-4 Flame Signal
AV Boiler B-4 Local Pressure Setpoint
AV Boiler B-4 Steam Pressure - Actual
BV Boiler B-4 Steam Pressure - HIGH Pressure -- ALARM
BV Boiler B-4 Steam Pressure - LOW Pressure -- ALARM
BV Boiler B-4 Local/Remote Status
BV Boiler B-4 Auto/Manual Status
BV Boiler B-4 Fuel Selected
BV Boiler B-4 Fuel Valve Open
AV Boiler B-4 Steam Flow to Feedwater Flow Ratio
BV Boiler B-4 HIGH Water Level -- ALARM
BV Boiler B-4 LOW Water Level -- ALARM
AV Boiler B-4 Temperature

BOILER B-5
BV Boiler B-5 Start Command
BV Boiler B-5 Status
AV Boiler B-5 Steam Flow ~
AV Boiler B-5 Gas Steam Total
AV Boiler B-5 Oil Steam Total
AV Boiler B-5 Gas Supply Flow
AV Boiler B-5 Gas Total
AV Boiler B-5 Fuel Oil Supply Flow
AV Boiler B-5 Feedwater Total
AV Boiler B-5 Drum Pressure
AV Boiler B-5 Drum Level
AV Boiler B-5 Boiler Feedwater Valve Position
AV Boiler B-5 Water Conductivity
AV Boiler B-5 Stack O2
AV Boiler B-5 Stack Temperature
AV Boiler B-5 Comb Air Temperature
AV Boiler B-5 FD Fan Speed
AV Boiler B-5 FD Fan Hz
AV Boiler B-5 FD Fan Power
AV Boiler B-5 FD Fan Electric Use
AV Boiler B-5 Firing Rate
AV Boiler B-5 Comb Eff
AV Boiler B-5 Flame Signal
AV Boiler B-5 Local Pressure Setpoint
AV Boiler B-5 Steam Pressure - Actual
BV Boiler B-5 Steam Pressure - HIGH Pressure -- ALARM
BV Boiler B-5 Steam Pressure - LOW Pressure -- ALARM
BV Boiler B-5 Local/Remote Status
BV Boiler B-5 Auto/Manual Status
BV Boiler B-5 Fuel Selected
BV Boiler B-5 Fuel Valve Open
AV Boiler B-5 Steam Flow to Feedwater Flow Ratio
BV Boiler B-5 HIGH Water Level -- ALARM
BV Boiler B-5 LOW Water Level -- ALARM
AV Boiler B-5 Temperature

BOILER B-6
BV Boiler B-6 Start Command
BV Boiler B-6 Status
AV Boiler B-6 Steam Flow ~
AV Boiler B-6 Gas Steam Total
AV Boiler B-6 Oil Steam Total
AV Boiler B-6 Gas Supply Flow
AV Boiler B-6 Gas Total
AV Boiler B-6 Fuel Oil Supply Flow
AV Boiler B-6 Feedwater Total
AV Boiler B-6 Drum Pressure
AV Boiler B-6 Drum Level
AV Boiler B-6 Boiler Feedwater Valve Position
AV Boiler B-6 Water Conductivity
AV Boiler B-6 Stack O2
AV Boiler B-6 Stack Temperature
AV Boiler B-6 Comb Air Temperature
AV Boiler B-6 FD Fan Speed
AV Boiler B-6 FD Fan Hz
AV Boiler B-6 FD Fan Power
AV Boiler B-6 FD Fan Electric Use
AV Boiler B-6 Firing Rate
AV Boiler B-6 Comb Eff
AV Boiler B-6 Flame Signal
AV Boiler B-6 Local Pressure Setpoint
AV Boiler B-6 Steam Pressure - Actual
BV Boiler B-6 Steam Pressure - HIGH Pressure -- ALARM
BV Boiler B-6 Steam Pressure - LOW Pressure -- ALARM
BV Boiler B-6 Local/Remote Status
BV Boiler B-6 Auto/Manual Status
BV Boiler B-6 Fuel Selected
BV Boiler B-6 Fuel Valve Open
AV Boiler B-6 Steam Flow to Feedwater Flow Ratio
BV Boiler B-6 HIGH Water Level -- ALARM
BV Boiler B-6 LOW Water Level -- ALARM
AV Boiler B-6 Temperature

MAIN STEAM HEADER
AV Steam Main Header Pressure
AV Steam Main Header Flow ~

PRESSURE REDUCING STATION
AV Steam Pressure
AV Steam Pressure -- HIGH Pressure ALARM
AV Steam Pressure -- LOW Pressure ALARM

DEAERATOR & BOILER FEEDWATER SYSTEM (DA-1)
BV Deaerator Receiver -- HIGH Level ALARM
BV Deaerator Receiver -- LOW Level ALARM
AV Deaerator Receiver Steam Pressure
AV Deaerator Receiver -- HIGH Pressure ALARM
AV Deaerator Receiver -- LOW Pressure ALARM
AV Deaerator Temperature
AV Deaerator Receiver – Emergency Makeup Valve Position
AV Deaerator Receiver -- Emergency Makeup Flow

BV Boiler Feedwater Pump #1 Command to Start -- Boiler/s Interlock
BV Boiler Feedwater Pump #1 Status
AV Boiler Feedwater Pump #1 Speed
AV Boiler Feedwater Pump #1 Hz
AV Boiler Feedwater Pump #1 Power
AV Boiler Feedwater Pump #1 Electric Use
AV Boiler Feedwater Pump #1 Run Hours
BV Boiler Feedwater Pump #2 Command to Start -- Boiler/s Interlock
BV Boiler Feedwater Pump #2 Status
AV Boiler Feedwater Pump #2 Speed
AV Boiler Feedwater Pump #2 Hz
AV Boiler Feedwater Pump #2 Power
AV Boiler Feedwater Pump #2 Electric Use
AV Boiler Feedwater Pump #2 Run Hours
BV Boiler Feedwater Pump #3 Command to Start -- Boiler/s Interlock
BV Boiler Feedwater Pump #3 Status
AV Boiler Feedwater Pump #3 Speed
AV Boiler Feedwater Pump #3 Hz
AV Boiler Feedwater Pump #3 Power
AV Boiler Feedwater Pump #3 Electric Use
AV Boiler Feedwater Pump #3 Run Hours
BV Boiler Feedwater Pump #4 Command to Start -- Boiler/s Interlock
BV Boiler Feedwater Pump #4 Status
AV Boiler Feedwater Pump #4 Speed
AV Boiler Feedwater Pump #4 Hz
AV Boiler Feedwater Pump #4 Power
AV Boiler Feedwater Pump #4 Electric Use
AV Boiler Feedwater Pump #4 Run Hours
AV Feedwater Header Pressure

DEAERATOR & BOILER FEEDWATER SYSTEM (DA-2)
BV Deaerator Receiver -- HIGH Level ALARM
BV Deaerator Receiver -- LOW Level ALARM
AV Deaerator Receiver Steam Pressure
AV Deaerator Receiver -- HIGH Pressure ALARM
AV Deaerator Receiver -- LOW Pressure ALARM
AV Deaerator Temperature
AV Deaerator Receiver – Emergency Makeup Valve Position
AV Deaerator Receiver -- Emergency Makeup Flow
BV Boiler Feedwater Pump #1 Command to Start -- Boiler/s Interlock
BV Boiler Feedwater Pump #1 Status
AV Boiler Feedwater Pump #1 Speed
AV Boiler Feedwater Pump #1 Hz
AV Boiler Feedwater Pump #1 Power
AV Boiler Feedwater Pump #1 Electric Use
AV Boiler Feedwater Pump #1 Run Hours
BV Boiler Feedwater Pump #2 Command to Start -- Boiler/s Interlock
BV Boiler Feedwater Pump #2 Status
AV Boiler Feedwater Pump #2 Speed
AV Boiler Feedwater Pump #2 Hz
AV Boiler Feedwater Pump #2 Power
AV Boiler Feedwater Pump #2 Electric Use
AV Boiler Feedwater Pump #2 Run Hours
BV Boiler Feedwater Pump #3 Command to Start -- Boiler/s Interlock
BV Boiler Feedwater Pump #3 Status
AV Boiler Feedwater Pump #3 Speed

AV Boiler Feedwater Pump #3 Hz
AV Boiler Feedwater Pump #3 Power
AV Boiler Feedwater Pump #3 Electric Use
AV Boiler Feedwater Pump #3 Run Hours
AV Feedwater Header Pressure
BV Condensate Receiver -- HIGH Level ALARM
BV Condensate Receiver -- LOW Level ALARM
BV Duplex Condensate Pump/s -- Stop Command
BV Duplex Condensate Pump/s -- Start Command
BV Condensate Pump #1 - Status
AV Condensate Pump #1 Speed
AV Condensate Pump #1 Hz
AV Condensate Pump #1 Power
AV Condensate Pump #1 Electric Use
AV Condensate Pump #1 Run Hours
BV Condensate Pump #2 – Status
AV Condensate Pump #2 Speed
AV Condensate Pump #2 Hz
AV Condensate Pump #2 Power
AV Condensate Pump #2 Electric Use
AV Condensate Pump #2 Run Hours
AV Condensate Tank Makeup Valve Position
AV Condensate Tank Temperature
AV Condensate Transfer Pump Header Pressure
AV Condensate Transfer Control Valve Position
AV Condensate Transfer Flow

BLOWDOWN SEPARATOR
AV Blowdown Separator Water to Drain -- Separator Temperature

MAIN FUEL OIL STORAGE TANKS & FUEL OIL PUMPS
BV Fuel Oil Storage Tank #1 -- HIGH Level ALARM
BV Fuel Oil Storage Tank #1 -- LOW Level ALARM
BV Fuel Oil Storage Tank #2 -- HIGH Level ALARM
BV Fuel Oil Storage Tank #2 -- LOW Level ALARM
BV Fuel Oil Pump #1 -- Start Interlock
BV Fuel Oil Pump #1 -- Status
BV Fuel Oil Pump #2 -- Start Interlock
BV Fuel Oil Pump #2 -- Status

3.5 ALARM REQUIREMENTS

A. All alarm conditions (ALL MTR (*), COS (~), LIMIT (~) and RTN (~) ALARM INFORMATION DESIGNATED IN THE POINTS LIST) shall be separately annunciated and their occurrence indicated by showing a red alarm icon on the current graphic display. A separate page shall be used to display alarm details. AVs and BVs read/written across 3rd party communication interfaces shall also be treated as I/O points for alarming purposes and alarmed as determined by the Client Agency.

B. The BAS Contractor shall meet with the Client Agency to determine routing requirements for all alarm information. Particular attention shall be paid to developing a routine procedure that prevents non-critical alarms from impacting critical system operation. The prioritization and routing shall be fully implemented to the satisfaction of the Client Agency. The ATC contractor, working in conjunction with Client Agency, shall implement automatic email of selected alarms to the designated Client Agency personnel. Additional method(s) of alarm annunciation shall be coordinated with the Client Agency.

C. The following alarm conditions, as further detailed by the Client Agency, shall also be detected and an appropriate alarm generated. The ATC contractor, working in conjunction with Client Agency, shall implement automatic email of selected alarms to the designated Client Agency personnel. Additional method of alarm annunciation shall be coordinated with the Client Agency.

1. Boiler failed to start/stop
2. Control valve position feedback does not agree with commanded position
3. High/low fuel oil level
4. High KW/ton performance
5. High/low boiler steam pressure
6. High/low boiler stack temperature

D. The BMS Contractor shall provide custom alarm reports as required for this project.

3.6 TREND REQUIREMENTS

A. All I/O points and setpoints shall be linked to BACnet trend objects. The controller(s) shall record a trend sample every 15 minutes (adj.) for each trend object and save the most recent 120 (adj.) samples.

B. AVs and BVs read/written across 3rd party communication interfaces shall also be treated as I/O points for trending purposes.

C. The following trends shall be implemented and automatically archived to the server as part of this project to aid in operating the building for maximum energy efficiency. Point selection shall be consistent with available memory and coordinated with the Client Agency prior to implementation. The ATC contractor, working in conjunction with Client Agency, shall implement automatic email of selected trends to the designated Client Agency personnel.

1. Fuel oil system – number of points and/or trends as determined by the Client Agency
2. Steam system overview – number of points and/or trends as determined by the Client Agency
3. Steam system flows – number of points and/or trends as determined by the Client Agency
4. Steam system MBH profiles (with OAT, OAH)
5. Boiler #2 - number of points and/or trends as determined by the Client Agency
6. Boiler #3 - number of points and/or trends as determined by the Client Agency
7. Boiler #4 - number of points and/or trends as determined by the Client Agency
8. Boiler #5 - number of points and/or trends as determined by the Client Agency
9. Boiler #6 - number of points and/or trends as determined by the Client Agency

D. The BMS Sub-Contractor shall provide custom trend reports as required for this project.

3.7 WARRANTY

A. The local field office shall warranty the BMS as described in Section 23 0900, paragraph 1.8 Warranty. The work of this Section will be subject to the warranty requirements of Section 23 0900, paragraph 1.8 Warranty.

3.8 WARRANTY ACCESS

A. The local field office shall provide warranty access as described in Section 23 0900, paragraph 3.6 Warranty Access. The work of this Section will be subject to the warranty access requirements of Section 230900, paragraph 3.6 Warranty Access.

3.9 APPLICATION DEVELOPMENT AND REVIEW

A. The control drawings and the sequences of operation are for conveying general concept only and are not meant to be inclusive of all hardware requirements or all functional sequence requirements. Refer to the complete package of contract drawings for equipment quantity and location information. Items mentioned in Sections 23 0900 and 23 0993, shown on the control drawings, mentioned in the sequences of operation or shown on other HVAC drawings shall become part of the work of this project without the necessity of being separately detailed in each of those applicable sections of the contract documents. Reference in one section of the contract documents shall be interpreted to include reference in all other applicable sections. Any additional hardware and/or software required to accomplish functional intent shall be provided (without additional cost to the Client Agency) just as though it were fully detailed on the contract documents.

B. The BMS Sub-Contractor shall be responsible for providing complete detailed sequences of operation for each piece of equipment or system regardless of the completeness and clarity of the sequences in the contract documents. These detailed sequences shall address all operating modes including, but not limited to, normal, failure, failure recovery. These detailed sequences shall also address all system interaction and operational interfaces and shall be required prior to beginning implementation of the application software and MMI package. The sequences of operation as written infer certain additional functionality in order to accomplish project intent. With that in mind, software review meetings shall be held with the Professional, Client Agency, Commissioning Agent and BMS Sub-Contractor to finalize details prior to beginning implementation of the application software and MMI package and again at regular intervals during initial operation of the system. Professional and/or Commissioning Agent shall coordinate scheduling and recording keeping. Following is a summary of anticipated review meetings and required follow-up actions by the BMS Contractor.

1. Review scope of software to be implemented. This shall be an interchange of ideas and operating characteristics of the equipment and facility. All data relative to system operations and design criteria shall be presented at this time. The BMS Contractor shall gather this data and structure the required software around this information. This shall occur prior to starting any software programming by the control installer. This meeting shall also establish the system and point naming conventions to be used throughout the project by the BMS Contractor. Naming conventions shall be approved by the Professional and the Client Agency. Colorgraphic screens hierarchy, layout, functionality and operator interaction, including alarming and trending, shall be presented for approval by the Professional and the Client Agency.
2. After one (1) to three (3) months of heating season operation, as deemed appropriate by any party, an operations/software review shall be held. Any changes required shall be implemented by the BMS Sub-Contractor after this meeting.
3. Prior to the beginning of the next heating season, a final heating season software review shall be held to review the operational sequences, resolve any issues that may have occurred and/or implement desired software changes to enhance the system operation.
4. Final software reviews shall be held for each system to review the operational sequences, resolve any issues that may have occurred and/or implement desired software changes to enhance the system operation.
5. All points picked up by the Master Control Panel and relayed to the panels, data acquisition system, and operator PC must be field verified by the vendor as part of the commissioning of the new boiler plant system before turning it over to the facility as a fully operation system.

END OF SECTION 23 0993

SECTION 230995 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. This specification is to cover a complete Variable Frequency Drive (VFD aka: VSD, AFD, ASD, Inverter, AC Drive, et al) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.

B. The drive manufacturer shall supply the drive and the necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFDs that are manufactured by a third party and “brand labeled” shall not be acceptable. Drive manufacturers who do not build their own power boards and assemblies, or do not have full control of the power board manufacturing and quality control, shall be considered as a “brand labeled” drive. Each VFD installed on this project shall be from the same manufacturer.

1.3 QUALITY ASSURANCE

A. Referenced Standards and Guidelines:

1. Institute of Electrical and Electronic Engineers (IEEE)

a. IEEE 519-1992, Guide for Harmonic Content and Control.

2. Underwriters Laboratories (as appropriate)

a. UL508
b. UL508A
c. UL508C

3. National Electrical Manufacturer’s Association (NEMA)

a. ICS 7.0, AC Adjustable Speed Drives

4. International Electrotechnical Commission (IEC)

a. EN/IEC 61800-3

5. National Electric Code (NEC)

a. NEC 430.120, Adjustable-Speed Drive Systems

6. International Building Code (IBC)

a. IBC 2012 Seismic – referencing ASC 7-05 and ICC AC-156

B. Qualifications:

1. VFDs and options shall be UL508 listed as a complete assembly. The base VFD shall be UL listed for 100 kA SCCR without the need for external input fuses.
2. CE Mark – The base VFD shall conform to the European Union Electromagnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2). Base drives that only meet the Second Environment (Category C3, C4) shall be supplied with filters to bring the drive into compliance with the First Environment levels.
3. The entire VFD assembly, including the bypass (if specified), shall be seismically certified and labeled as such in accordance with the 2012 International Building Code (IBC):

    a. VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.
    b. Seismic importance factor of 1.5 rating is required and shall be based upon actual shake test data as defined by ICC AC-156.
    c. Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in the three axes of motion.
    d. Special seismic certification of equipment and components shall be provided by OSHPD preapproval.

4. Acceptable Manufacturers

    a. ABB ACH Series supplied by RCKCO.
    b. Alternate manufacturer's requests must be submitted via e-Builder to the Engineer for approval at least 20 working days prior to bid. Approval does not relieve the supplier of specification requirements.

5. Factory authorized start up and Client Agency training should be provided locally upon request.

1.4 SUBMITTALS

A. Submittals shall include the following information:

1. Outline dimensions, conduit entry locations and weight.
2. Customer connection and power wiring diagrams.
3. Complete technical product description including a complete list of options provided. Any portions of this specification not met must be clearly indicated or the supplier and contractor shall be liable to provide each additional component required to meet this specification.

1.5 BUILDING INFORMATION MODELING (BIM)

A. BIM objects shall contain IFC parameters and associated data applicable to building system requirements. These elements shall support the analytic process including size, clearance, location, mounting heights, and system information where applicable.

B. VFD BIM models shall contain as a minimum the following attributes:

1. Input voltage
2. Current rating
3. Model number
4. Manufacturer
5. Enclosure type

PART 2 – PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

A. The VFD package as specified herein and defined on the VFD schedule shall be enclosed in a UL Type enclosure (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer in an ISO9001 facility.

B. The VFD shall provide full rated output from a line of ±10% of nominal voltage. The VFD shall continue to operate without faulting from a line of +30% to -35% of nominal voltage.

1. VFDs shall be capable of continuous full load operation under the following environmental operating conditions:

a. -15 to 40° C (5 to 104° F) ambient temperature. Operation to 50° C shall be allowed with a 10% reduction from VFD full load current.
b. Altitude 0 to 3300 feet above sea level. Operation to 6600 shall be allowed with a 10% reduction from VFD full load current.
c. Humidity less than 95%, non-condensing.

C. Each VFDs shall have the following standard features:

1. The circuit boards shall be coated to protect against corrosion.
2. Each VFD shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
3. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate “bumpless transfer” of speed reference when switching between “Hand” and “Auto” modes. There shall be fault reset and “Help” buttons on the keypad. The Help button shall include “on-line” assistance for programming and troubleshooting.
4. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. VFD programming shall be held in non-volatile memory and is not dependent on battery power
5. The VFD’s shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram each parameter and customer interface for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.
6. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required, based on the temperature of and run command to the drive. VFD protection shall be based on thermal sensing and not cooling fan operation.
7. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).
8. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
9. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds every minute. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.
10. VFDs through 200 HP shall have internal swinging (non-linear) chokes providing impedance equivalent to 5% to reduce the harmonics to the power line. Swinging choke

shall be required resulting in superior partial load harmonic reduction. Linear chokes are not acceptable. 5% impedance may be from dual (positive and negative DC bus) chokes, or 5% swinging AC line chokes. VFD's with only one DC choke shall add an AC line choke.

11. The input current rating of the VFD shall not be greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.122. Input and output current ratings must be shown on the VFD nameplate.
12. The VFD shall include a coordinated AC transient surge protection system consisting of 4 MOVs (phase to phase and phase to ground), a capacitor clamp, 1600 PIV Diode Bridge and internal chokes. The MOV's shall have a minimum 125 joule rating per phase across the diode bridge. VFDs that do not include coordinated AC transient surge protection shall include an external TVSS (Transient Voltage Surge Suppressor).
13. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.
14. The VFD shall include multiple "two zone" PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two-zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. Each of the VFD PID controllers shall include the ability for "two zone" control.
15. If the input reference is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.
16. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.

D. Each VFD shall have the following adjustments:

1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.
2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.
3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (i.e. valves, dampers, etc.). Each set point, process variable, etc. shall be accessible from the serial communication network.
4. Two (2) programmable analog inputs shall accept current or voltage signals.
5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.
6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external

devices. Each digital input shall be programmable to initiate upon an application or removal of 24VDC.

7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable. Drives that have only two (2) relay outputs must provide an option card that provides additional relay outputs.
8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display “start enable 1 (or 2) missing”. The safety input status shall also be transmitted over the serial communications bus.
9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.
10. Seven (7) programmable preset speeds.
11. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.
12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.
13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.
14. The VFD shall include password protection against parameter changes.

E. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:

1. Start-up assistant
2. Parameter assistants

    a. PID assistant
    b. Reference assistant
    c. I/O assistant
    d. Serial communications assistant
    e. Option module assistant
    f. Panel display assistant
    g. Low noise set-up assistant

3. Maintenance assistant
4. Troubleshooting assistant

5. Drive optimizer assistants

F. Each applicable operating value shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall always be capable of being displayed. The display shall be in complete English words (alpha-numeric codes are not acceptable):

1. Output Frequency
2. Motor Speed (RPM, %, or Engineering units)
3. Motor Current
4. Motor Torque
5. Motor Power (kW)
6. DC Bus Voltage
7. Output Voltage

G. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override the other inputs (analog/digital, serial communication, and the keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.

H. Serial Communications

1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. [Optional protocols for LonWorks, Profibus, EtherNet, BACnet IP, and DeviceNet shall be available.] Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. Each protocol shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.
2. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support each BIBB defined by the BACnet standard profile for a B-ASC including, but not limited to:

    a. Data Sharing – Read Property – B.
    b. Data Sharing – Write Property – B.
    c. Device Management – Dynamic Device Binding (Who-Is; I-Am).
    d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
    e. Device Management – Communication Control – B.

3. Serial communication capabilities shall include, but not be limited to; run-stop controls, speed set adjustment, and lock and unlock the keypad. The drive shall have the capability of allowing the BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The BAS shall also be capable of monitoring the VFD relay output status, digital input status, and the analog input and analog output values. The diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.
4. Serial communication in bypass (if bypass is specified) shall include, but not be limited to;

bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the BAS to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The BAS shall also be capable of monitoring the bypass relay output status, and each digital input status. Each bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.

5. The VFD / bypass shall allow the BAS to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, each drive and bypass' digital input shall be capable of being monitored by the BAS system. This allows for remote monitoring of which (of up to 4) safeties are open.
6. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.

I. EMI / RFI filters. Each VFD shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2) with up to 100 feet of motor cable. Second environment (Category C3, C4) is not acceptable, no Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment (C2).

J. DRIVE OPTIONS – Options shall be furnished and mounted by the drive manufacturer as defined on the VFD schedule. Each optional feature shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

K. Provide Passive Harmonic Filter manufactured by Trans Coil model HGP Series Harmonic Filter Only, shall be mounted and wired by VFD's manufacturer as an integral part of the Redundant Drive Cabinet it shall be wired in parallel to the VFD. Include isolating contactor and relays for filter drop-in and drop-out at (programmable) low frequency VFD operation. When bypasses are required, interlock the filter to drop out while the bypass is in operation. Filter shall limit current distortion to 5% TDD (current distortion) at full load when measured at the filter input terminal.

L. Output LC Filter (if required in VFD schedule): Provide where indicated to reduce motor insulation stress a load side V1K series output LC (dV/dt) filter. Provide integrated dV/dt filter as part of the drive package installed within the drive enclosure.

M. Local Disconnect Safety Circuit: Drive will have capability to shut-off the VFD when an auxiliary contact in a local disconnect switch is opened. This will ensure the VFD is not operating while the local disconnect is open. Disconnect with an 'early break' auxiliary contact and wiring of the interlock circuit to be by the Electrical Contractor.

2.2 TOTAL HARMONIC DISTORTION (THD) COMPLIANCE

A. When specified VFD's are being connected to a "New" power distribution system the Mechanical Contractor shall obtain, from the Electrical Engineer, the Project's power distribution single line diagram and both primary and distribution transformer data and furnish this information/drawings to the VFD manufacturer. The VFD manufacturer shall provide an analysis of the system.

B. Where specified VFD's are being connected to an "Existing" power distribution system the Mechanical Contractor shall arrange and pay for the harmonic testing of the power distribution panelboard/switchboard indicated as serving the VFD's and provide a report to the VFD manufacturer for analysis of the system. The analysis shall review the potential for the proposed equipment, and any existing equipment, to meet IEEE 519 (tables 10.2 and 10.3) recommendations at the Point of Common Coupling (PCC).

C. The result of the analysis shall determine if additional power quality improvement measures should be included in the proposal to meet the THD recommendations of IEEE 519. Any power quality improvement measures shall be provided by the Mechanical Contractor.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive according to the recommendations of the VFD manufacturer as outlined in the VFD installation manual.

B. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

A. Factory start-up shall be provided for each drive by a factory authorized service center. A start-up form shall be filled out for each drive with a copy provided to the Client Agency, and a copy kept on file at the manufacturer.

B. The equipment supplier shall provide sufficient required on-site time to coordinate, checkout and confirm BAS communication interface operation to the satisfaction of the project BAS contractor. On site visits shall be scheduled by the BAS contractor through the mechanical contractor as appropriate for the equipment to which the BAS is being interfaced.

3.3 PRODUCT SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line connected to factory support personnel located in the US shall be available. Technical support offered only through the local sales office is not acceptable.

B. Training shall include installation, programming and operation of the VFD, bypass and serial communication. Factory authorized start up and Client Agency training to be provided locally upon request.

3.4 WARRANTY

A. The VFD Product Warranty shall be 36 months from the date of factory shipment. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

END OF SECTION 23 0995

SECTION 23 1113 – FUEL OIL PIPING SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The Specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

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

C. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.3 SUMMARY

A. Perform all Work required to provide and install fuel oil piping systems.

1.4 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI B31.1 - Power Piping.
2. ANSI B31.4 - Liquid Petroleum Transportation Piping Systems.
3. ANSI B31.9 - Building Service Piping.
4. API 2000 - Venting Atmospheric and Low Pressure Storage Tanks.
5. ASME Section 9 - Welding and Brazing Qualifications.
6. ASME B16.3 - Malleable Iron Threaded Fittings.
7. ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
8. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
9. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
10. ASTM D2310 - Machine-Made Reinforced Thermosetting Resin Pipe.
11. ASTM D2996 - Filament-Wound Reinforced Thermosetting Resin Pipe.
12. NFPA 30 - Flammable and Combustible Liquids Code.
13. NFPA 31 - Installation of Oil Burning Equipment.
14. TNRCC, Chapter 334 - Underground and Aboveground Storage Tanks.
15. Conform to applicable EPA, State and Local Regulations for installation of fuel oil systems.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum three (3) years documented experience.

B. Installer: Company specializing in performing the work of this Section with minimum three (3) years documented experience.

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

D. Welding Materials and Procedures: Conform to ASME Code.

E. Welders Certification: In accordance with ASME Section 9.

F. Maintain one copy of each document at the Project Site.

1.6 SUBMITTALS

A. Product Data:

1. Provide data on pipe materials, pipe fittings, valves and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

B. Record Documents:

1. Record actual location of piping system, storage tanks and system components.
2. Shop Drawings: Indicate tanks, system layout, pipe sizes, location and elevations. For fuel oil tanks, indicate dimensions and accessories including manholes and hold down straps.

C. Operation and Maintenance Data:

1. Include installation instructions, spare parts lists, exploded assembly views.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to the Project Site under provisions of Division 01 and Division 20.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 FUEL OIL PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53 or ASME B36.10, Schedule 40 black.

1. Fittings: ASTM B16.3, black malleable iron, Class 150 (300 lb. WOG), threaded.
2. Joints: NFPA 30, threaded ANSI B31.4.
3. Thread Sealant: Make up all threaded connections utilizing "Gasoila Soft Set" manufactured by Federal Process Company, Cleveland, Ohio or equal as approved by the professional.

2.3 FLANGES, UNIONS AND COUPLINGS

A. Pipe Sizes 3 Inches and Under:

1. Ferrous pipe: Class 300 all malleable iron threaded unions.
2. Thread Sealant: Same as specified for fuel oil piping above ground.

2.4 BALL VALVES

A. Manufacturers:

1. Stockham Model S-216-BR-R-T.
2. Other acceptable manufacturers offering equivalent products.

a. Apollo Model 70-100.
b. Nibco Model T-580-BR-R-70.

B. Bronze two-piece body, chrome plated brass or bronze ball, Teflon seats and stuffing box ring, lever handle, threaded ends.

C. Thread Sealant: Same as specified for fuel oil piping above ground.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that excavations are excavated to required grade, are dry, and not over-excavated.

B. Ream pipe and tube ends. Remove burrs.

C. Remove scale and dirt, on inside and outside, before assembly.

D. Prepare piping connections to equipment with threaded unions.

3.2 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Piping Installation:

1. Use compatible sealant when assembling all threaded joints and fittings.
2. Route piping in orderly manner and maintain gradient.
3. Install piping to conserve building space and not interfere with use of space.
4. Group piping whenever practical at common elevations.
5. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
6. Provide clearance for access to valves and fittings.
7. Provide access where valves and fittings are not exposed.
8. Prepare pipe, fittings, supports and accessories not pre-finished, ready for finish painting.
9. Identify piping systems including underground piping.
10. Install valves with stems upright or horizontal, not inverted.
11. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of completed system.
12. Slope underground fuel supply and vent piping back to storage tank.

13. Secondary containment pipe shall be positioned over product pipe prior to bonding the product piping. After testing the product pipe, the containment fittings shall be assembled. The containment system shall then be tested.

3.3 TESTING

A. Pneumatically test tanks in accordance with manufacturer's recommendations upon arrival at the Project Site and after tank installation to assure tank integrity.

B. Primary (Product) Piping Test: Hydrostatically test system at 90 psi and carefully check for leaks. Repair all leaks and retest until proven watertight. Flush system thoroughly with diesel fuel until all moisture or debris is removed and diesel is clear. Fill system with clean diesel fuel, close end valves and allow system to remain full. Legally dispose of flush diesel.

C. Secondary Containment Piping Test: Seal secondary containment piping to primary piping at both ends with concentric termination fittings as recommended by the manufacturer. Provide test gauge and pipe connection at this point for pneumatic testing. Pneumatically test system at 58 psi for ten (10) minutes, then soap all joints and check for leaks. Retest until there are no leaks and system is proven tight.

D. The piping system shall be installed as specified on contract drawings or at the discretion of the installing contractor to provide a complete pipe conveyance system as required for the project. Pipe sizes shall be as shown on the contract drawings.

E. All pipe and fittings installed or constructed in the field shall be assembled and fusion welded by employees of the contractor who have been satisfactorily trained and certified by the manufacturer. When required the pipe manufacturers authorized trainer shall train the contractor’s employees in the proper assembly and fusion welding procedures necessary for the project.

F. The piping system shall be installed in strict accordance with the manufacturers current installation published installation instructions. The installing contractor shall be responsible for all necessary specialty tools and consumables required for a complete testable piping installation.

END OF SECTION 23 1113

SECTION 23 1118 – FUEL OIL PUMPS AND ACCESSORIES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SECTION INCLUDES

A. Automatic Fuel Oil Transfer System.

B. Fuel Oil Specialties

1.4 SUBMITTALS

A. Product Data: Submit data on general layout, dimensions, size, and location of connections, wiring diagram and piping detail.

B. Submit manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include manufacturer's descriptive literature; operating instructions, cleaning procedures, replacement parts list and maintenance and repair data.

1.6 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacturing of the types and sizes required, whose products have been satisfactorily serviced, in Pennsylvania, under similar conditions for no less than ten (10) years.

B. Fuel oil transfer system and day tank storage set must be manufactured in the United States and furnished with Pennsylvania ST Forms.

C. Vendors: Boiler/burner unit shall be furnished as complete factory approved and integrated factory assembled unit. A single local factory trained organization shall assume full responsibility for the supervision of the installation and the start-up of this equipment. Firm must have a minimum of twenty five (25) operating reference projects utilizing the specified equipment.

D. Fuel oil transfer system must be furnished by the same vendor for unit responsibility.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable N.F.P.A. 70 code for internal wiring of factory wired equipment.

B. Units: U.L. 508A labeled.

C. Conform to National Fire Protection Associate (N.F.P.A.) 30-08 – Flammable and Combustible Liquids Code.

D. Conform to National Fire Protection Associate (N.F.P.A.) 31-06 – Installation of Oil Burning Equipment.

E. Conform to National Fire Protection Associate (N.F.P.A.) 70-08 – National Electrical Code.

F. Conform to Underwriters Laboratories Inc. (UL) 142-06 – Steel Aboveground Tanks for Flammable and Combustible Liquids.

G. Contractor shall obtain and complete all tank permit and registration forms required by governmental authorities.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect units before, during and after installation from damage to casing by leaving factory-shipping packaging in place until immediately prior to final acceptance.

B. Manufacturer's local representative shall be on site during the boiler rigging and installation to ensure proper handling.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Provide Client Agency with manufacturer's warranty for the entire system, including hardware, software and components for a period of one (1) year from date of substantial completion and acceptance by Client Agency, in accord with conditions contract.

B. Manufacturer defects or damage arising during the one (1) year warranty period shall be prepaid or corrected to the satisfaction of the Client Agency at no additional cost.

1.11 MAINTENANCE SERVICE

A. Furnish service and maintenance of fuel oil transfer system and day tank storage set for one (1) year from date of substantial completion.

B. Provide emergency call back service at all hours for this maintenance period.

C. Maintain locally, near place of the work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

D. Perform maintenance work using qualified personnel under supervision of boiler manufacturer's representative.

1.12 MAINTENANCE MATERIALS

A. Provide spare parts lists and installation, operation and maintenance manuals.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis of design Preferred Utilities Manufacturing Corp.

B. North American.

C. Simplex.

D. Approved manufacturer by the professional.

E. The fuel oil transfer system, fuel oil day tank storage set and fuel oil specialties must be provided by the same vendor for unit responsibility.

2.2 AUTOMATIC FUEL OIL TRANSFER SYSTEM

A. Supply a self contained, automatic fuel oil transfer and monitoring system to ensure a reliable supply of fuel oil to the boilers. The fuel oil transfer system shall include:

1. Automatic pump set lead/lag.
2. L.C.D. operator display.
3. Manual back up stations.
4. Time/date stamped alarm and event summary.
5. The system shall include the capability to communicate to the building automation system via ModBus protocol.
6. The system shall interface with the boiler room master control system, Building Automation System, and boilers.
7. Dial out capabilities to an alphanumeric pager system.

B. The control system shall be a microprocessor based design with field expandable plug in input/output modules. The automatic fuel oil transfer pump and straining set and monitoring system shall be Preferred Utilities Manufacturing Corp., Danbury, CT Model ATPS-201-ZCSE with three (3) fuel oil pumps as furnished and distributed by Combustion Service & Equipment Co., Pittsburgh, PA. or equal as approved by the professional. Three (3) fuel oil pumps shall be rated at 340 GPH of #2 fuel oil against a discharge pressure of 50 psig.

2.3 PUMP SET AND CONTROL CABINET

A. The pump set and control cabinet shall be completely pre-wired and tested to ensure job site reliability. The pump set and control cabinet shall be the product of one manufacturer for single source responsibility. Provide a factory assembled steel enclosure with all operator interface control switches, indicators and displays physically separated from any field terminations. Manual backup control switches and indicators must be protected from unauthorized operation by a key lockable door with a viewing window.

B. The control strategy shall be microprocessor based. Relay logic shall not be acceptable. The control strategy shall be factory configured and stored on an E.E.P.R.O.M., and shall be password protected from reconfiguration by unauthorized/unqualified personnel. The controller shall be designed so that it will “fail-safe” in the even there is a microprocessor failure. Control hardware shall include combination magnetic motor starters with overload protection and circuit breakers. These interlocks must continue to ensure safe pump operation even if the controller has failed or is out of service and the pump set is operated in manual “hand” mode. Control panel shall include a control transformer.

C. The control system shall include:

1. A 16 line x 40 character or greater L.C.D. display for pump set status.

2. Alarm listing.
3. Trouble shooting functions.

D. Provide a tactile feedback and numeric keypad for data entry. Provide dedicated pushbuttons for alarm silence and for the home page display and a “Hand-Off-Automatic” control switch for each fuel pump. In “Hand” position the pump shall be capable of manual operation in the event of a controller failure. The control system shall monitor the position of each “Hand-Off-Automatic” control switch. Should a switch be put into the “Off” position, the controller shall log the event with a time/date stamp and store within the controller memory. Provide an Elapsed Time Recorder (E.T.R.) to measure running time for each pump. Provide a fuel oil overview display (home page) capable of simultaneous viewing of pump set status, or future main storage tank status. The fuel oil overview display shall include the following information:

1. Lead pump selection – auto/manual.
2. Pump status – off/run/standby.
3. Three (3) most recent alarms.

E. The control cabinet shall be manufactured and labeled in accordance with U.L. 508A. Simply supplying U.L. recognized individual components is not sufficient. The assembled control cabinet, as a whole, must be inspected for proper wiring methods, fusing, a lockable disconnect switch sized for the entire motor and control load, etc., and must be labeled as conforming to U.L. 508A. Inspection and labeling shall be supervised by U.L. or other OSHA approved Nationally Recognized Test Lab (N.R.T.L.). Lack of a N.R.T.L. certified U.L. 508A wiring methods inspection and label will not be accepted.

2.4 ALARM AND EVENT LOGS

A. The control system shall include 200 alarms, events, and operator actions memory minimum. Provide an alarm display page for viewing the most recent eight (8) alarms/events with scrolling capability to view the complete 200 point alarm/event memory. Each event and alarm condition must be displayed with a distinct, descriptive, English language description and time/date stamp. New alarms shall trigger the common alarm output relay. Events shall be recorded, but shall not trigger an alarm. A dedicated alarm silence button shall silence the alarm output. The control system shall record and annunciate the following alarms:

1. Pump thermal overload.
2. Pump loss of flow.
3. Pump set failure.

B. The control system shall record the following events:

1. Pump started.
2. Pump control switch in “Off” position.
3. Pump set prime test OK.
4. Pump selected as lead.

2.5 FUEL PUMP ALTERNATION AND LEAD/LAG OPERATION

A. Provide automatic, microprocessor based fuel oil transfer pump control based upon a call for oil for either the boilers. The boiler fuel pump shall be energized when ever a boiler is enabled to fire with fuel oil until the demand is removed. Upon the next call for fuel, the lead pump shall be automatically alternated. The lead pump shall automatically rotate every 1 to 168 hours or shall be manually selected by the operator. The smaller fuel oil pump shall not be part of the automatic lead/lag sequencing, but shall be utilized for the back-up pump sequencing. Upon detection of loss of flow or pressure or lead pump thermal overload the control system shall automatically energize the backup pumps and de-energize the lead pump.

2.6 AUTOMATIC PUMP PRIME AND SUCTION LINE INTEGRITY CHECK

A. The control system shall include a battery backed, real time clock and must be capable of automatically energizing the lead pump once everyday. This is to verify suction piping integrity and pump prime and verify pump operation. Once the lead pump has proven satisfactory operation, the lag pump shall be energized and run through the same test. These tests shall be recorded in the controller memory with a time/date stamp for later verification. If either lead or lag pump fails any of these tests, the control system shall generate an audible and visual alarm and log the “Failed Pump” condition

2.7 PIPING AND MOUNTING

A. Provide a triplex pump and straining set that is factory assembled with components piped and mounted on a continuously welded steel plate containment basin with 3” steel side rails. Provide a ½” containment basin plugged drain connection. The basin shall be sized to contain (capture) potential leaks from all factory installed piping and components. Pipe shall be Schedule 20 A.S.T.M. A-53 Grade “A” with A.N.S.I. B16.3 Class 150 malleable iron threaded fittings.

B. Provide and mount three (3) positive displacement rotary type pumps, with cast iron housing and self adjusting mechanical, carbon ring seals. Pumps that have aluminum, brass, or bronze housings or rotors are not acceptable. Packing gland equipped pumps, close coupled pumps, carbonator shaft mounted pumps or centrifugal pumps are not acceptable.

C. Each pump shall be driven by a 460/3/60, ½ H.P., T.E.F.C., rigid base, standard N.E.M.A. frame motors. Pump and motor assemblies shall be factory assembled on a structural steel channel. Rotating parts shall have a steel OSHA guard.

D. Provide and mount six (6) pump isolation valves. Locate one (1) valve on the suction and discharge side of each pump. Isolation valves will allow offline pump maintenance without system loss of availability. Isolation valves shall be ball type valves to provide full flow while open and positive shutoff when closed. Additionally, three (3) check valves shall be provided and mounted, one (1) located on the discharge of each pump.

E. Provide and mount three (3) simplex strainers with forty (40) mesh baskets, one (1) located on the suction side of each pump. Oil strainers shall have cast iron body, with threaded connections, sized as shown on the drawings and suitable for working pressures to 200 psig. Clamped cover and handle shall permit easy removal of the basket.

F. Provide and mount three (3) relief valves sized to relieve the full outlet flow of the pump without causing the pump motor to overload or any components pressure rating to be exceeded if the discharge is inadvertently valved off. Relief valves must be externally mounted from the pumps and piped to the return line in the field according to N.F.P.A. 30. Pump internal relief valves shall not be accepted. Relief valves shall be equal to Preferred Model RZCSE.

G. Provide and mount a compound gauge on the suction side of the strainer. The gauge shall read 30” vacuum 15 psig. Provide and mount a pressure gauge on the discharge side of each pump. Gauges selected to provide mid scale readings under normal operating pressures. Gauges’ mechanism shall be spring suspended to resist the effect of shocks and pulsations. Each gauge shall be equipped with an isolation ball valve.

H. Provide a time delayed flow sensing switch on the discharge of the pump set to bring on the lag pump should the lead pump fail to maintain flow. Flow switch shall be vane operated to actuate a single double throw snap switch. Switch shall be rated for 1,450 psig. Provide a flow switch outlet isolation valve for maintaining the flow switch without draining the fuel system.

2.8 COMMUNICATIONS

A. The pump set must include an optically isolated RS485 ModBus communications data highway.

1. The RS485 protocol shall allow:
2. Auto/manual mode change.
3. Stand-by pump selection.
4. Sensing and silencing alarms.
5. Change of any configuration parameter.
6. Change of timers, etc.

B. The control system shall have the ability to “dial out” to an alphanumeric pager system via field installable plug in option modules.

2.9 FUEL OIL SPECIALTIES

A. The following fuel oil specialty valves and control items shall be furnished by the fuel oil transfer system manufacture for unit responsibility, no exceptions. All valves and control items are detailed on the contract drawing and hereinafter described:

1. Furnish and install for each boiler a quick closing, spring loaded and thermally actuated fusible element which melts at 165˚F causing the valve to close tightly. The valve shall be a Preferred Utilities Manufacturing Corp., Danbury, CT, Fusomatic Gate Valve or equal as approved by the professional.
2. Furnish and install at the high point of the oil suction line dual U.L. listed and labeled Anti-Syphon Valves. Valves that do not have an Underwriters Laboratory certification, listing and label and do not conform to Local, State, and Federal Fire Codes shall not be acceptable. The Anti-Syphon Valve reduces fire hazards and prevents oil spills caused by oil being siphoned from the storage tank onto the equipment room floor. The valve shall automatically shut off the oil flow in the event of a broken or inadvertently left open oil suction line. In the event of a fire, to avoid thermal expansion induced valve failure the Anti-Syphon Valve body material must be bronze. Anti-Syphon Valves supplied with cast iron bodies or without U.L. labels shall be removed and a U.L. certified bronze body valve will be installed at the contractor expense. The valve shall be sized to meet the flow and vertical pipe height requirements of the system. The valve shall be a Preferred Utilities Manufacturing Corp., Danbury, CT Model A Anti-Syphon Valve or equal as approved by the professional.
3. All expansion and pressure relief valves shall be sized and located as shown on project drawings. Valve bodies shall be one (1) piece bronze construction suitable for pressures up to 300 psig. Valves shall be Model R as furnished by Preferred Utilities Manufacturing Corp., Danbury, CT or equal as approved by the professional.
4. Furnish and install a Vacuum Breaker Valve into a riser line as shown on the contract drawings. The valve shall prevent excessive vacuums that can disrupt fuel system operation or damage equipment. The valve shall automatically open to admit air when an unwanted vacuum develops. Provide and install a Preferred Standard Vent Protector to prevent water and debris form entering the riser. The valve shall be a Preferred Utilities Manufacturing Corp., Danbury, CT, Model VB Vacuum Breaker Valve or equal as approved by the professional.
5. Provide and install Back Pressure Regulating Valves as shown on the contract drawings. The valve shall be Preferred Utilities Manufacturing Corp., Danbury, CT, Model VCSE or equal as approved by the professional. The valve shall be diaphragm operated with 250 lb. cast iron body, hardened stainless steel trim with an adjustable spring range.
6. Provide and install Pressure Regulating Valves as shown on the contract drawings. The valve shall be Preferred Utilities Manufacturing Corp., Danbury, CT, Model ZCSE or equal as approved by the professional. The valve shall be diaphragm operated with 250 lb. cast iron body, hardened stainless steel trim with an adjustable spring range.

2.10 FACTORY TESTING

A. Prior to shipment, the manufacturer shall test all “Packaged” assemblies. A copy of the test procedures shall be sent to the consulting engineer and Client Agency. The Client Agency’s and or the consulting engineer at their discretion shall observe this and all other tests.

B. Electrical components shall be functionally tested with all instruments and controls. Settings of all instruments and controls shall be verified for conformance to these specifications. A certificate of factory testing, together with a copy of the wiring diagram shall be placed in the control cabinet prior to shipment. The U.L. 508 label shall be affixed to the inside of the cabinet.

C. Pump set must be fully tested prior to shipment. Testing shall include both a pressure and vacuum testing period. First, the complete pump set shall be pressure tested to rated pressure using an air pressure source. The test shall confirm that the pump set piping system can maintain rated pressure for four (4) hours. Next, the complete pump set shall be brought to a vacuum greater than 25” Hg. The test shall confirm that the pump set piping system can maintain vacuum for four (4) hours. Following a pressure and vacuum test the pump set shall be given a full operational test. The pump set shall be connected to a fuel oil supply and return. The pump set shall be operated normally. Motor amps shall be noted at no load and full load for each motor. The motor amps shall be within 10% of rated motor amps. During the test the relief valve shall be set and tested. Operation of pump set instrumentation shall be tested7 A copy of the test procedures shall be sent to the consulting engineer and Client Agency. The Client Agency’s and or the consulting engineer, at their discretion, shall observe this and all other tests. A certificate of factory testing, together with a copy of the wiring and arrangement diagrams shall be placed in the control cabinet prior to shipment.

2.11 INSTALLATION, START-UP, TRAINING AND SERVICE

A. Installation shall be in strict accordance with manufacturer’s instructions.

B. The contractor shall provide the services of the manufacturer’s technician to monitor the installation, start-up, test, and calibrate the equipment. The manufacturer’s technician shall also provide training. The fuel handling system as a whole shall be functionally tested. All instrument settings shall be verified for conformance to these specifications.

C. Provide two (2) days of factory certified service for the start-up and certification of the fuel oil handling system. Provide for one (1) hour training session in the proper operation and maintenance of the equipment. Training sessions shall cover the operation, troubleshooting and maintenance of the fuel handling equipment. A letter from the fuel oil handling system manufacturer shall be provided to the consulting engineer and Client Agency stating that the system received its factory start-up and that all components are in working order.

D. The service organization shall provide documentation that all service technicians are tested and comply with the standard set forth in the United States Department of Transportation (U.S. Dot) Drug and Alcohol Policy, Title 49DFR, Parts 199 and 40, Research and Special Programs Administration (R.S.P.A.).

E. All boiler and control system supervision, start-up and warranty service shall be paid at the specified prevailing wage.

PART 3 - EXECUTION

3.1 NOT APPLICABLE TO THIS SECTION

END OF SECTION 23 1118

SECTION 23 2113 – HVAC PIPING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SCOPE

A. The pipe and fittings for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.1 CIRCULATING WATER PIPING

A. Circulating Water Piping shall include the following:

1. Drain piping
2. Relief valve piping
3. Vent Piping

B. All new circulating water piping shall be Schedule 40, welded black steel pipe, conforming to ASTM Specifications A53. Weight and dimensions shall conform to ANSI Standard B36.10.

C. In lieu of using Schedule 40 black steel pipe and fittings for circulating water piping, the Contractor shall have the option of using Type L hard temper copper tubing assembled with wrought copper solder end fittings. Solder shall be 95-5 tin-antimony.

D. Circulating water piping systems shall be two-pipe forced circulation. Supply and return mains shall be run level. For up-feed connections and risers, branches shall be taken from main with 90 degree top connections and down-feed branches and risers shall be taken from the main with 90 degree bottom connections.

E. High points and drops of the piping system shall be provided with air vents of type specified in Section 23 0523.

F. Furnish and install inverted eccentric reducers in horizontal lines where reduction or increase in main size is shown. Top of pipe shall be level.

G. Ample provision for expansion and contraction of piping on all branch connections from mains and risers shall be provided.

H. Piping concealed in walls, partitions, above ceilings and other locations shall be tested with air or nitrogen with pressure held at 150 PSIG for two hours. Correction shall be made for changes in ambient temperatures.

I. Piping connections at the boilers, up to and including the first valve, shall be code welded in accordance with ASME regulations and as required by the State Department of Labor and Industry. Screwed and flanged connections may be made at the boilers where permitted by the State Department of Labor and Industry.

2.2 CHEMICAL FEED PIPING

A. Chemical feed piping shall be Schedule 80 black steel pipe. PVC or polyethylene rigid pipe and fittings may be used where recommended or required by the chemical treatment equipment manufacturer; however, piping must not be subject to high temperatures beyond the capability of the pipe.

2.3 COLD WATER MAKE-UP PIPING

A. From outlets on cold water mains, furnish and install all cold water makeup piping to the following:

1. Steam Systems

B. Makeup piping shall be complete with all valves, strainers, backflow preventers, pressure-reducing valves, fittings and insulation for complete installations. Flexible connectors on makeup water piping shall be installed as shown on the drawings.

C. Cold water make-up lines shall be Type L hard temper copper tubing assembled with wrought copper solder end fittings.

2.4 NATURAL GAS PIPING

A. Natural gas piping will be extended by the 0.2 Contractor and terminated at locations near the burners. The Heating Contractor shall properly connect to gas outlets, furnish and install lubricated gas cocks, and shall furnish and install gas line to each gas burner. A full line size gas cock shall be provided on gas line to each burner. Automatic controls for each burner, gas pressure regulator, and pilot line shall be installed to perform all function herein specified and to meet the requirements of Industrial Risk Insurers' (IRI). Gas vent piping shall be extended to the exterior of the Building in accordance with applicable codes and regulations. The gas vent piping vent shall be extended through the roof with a pipe portal.

B. All gas piping shall be Schedule 40, black steel pipe, conforming to ASTM Specifications A53 and ANSI Standard B36.10. Gas piping 2-1/2" and larger shall be seamless and assembled with seamless forged steel welded fittings. Gas piping 2" and smaller shall be assembled with malleable iron screwed fittings. Galvanized pipe or fittings are not permitted. Gas piping shall be furnished and installed in strict accordance with the requirements of the local gas company.

2.5 JOINTS AND CONNECTIONS

A. Screwed Connections:

1. All joints in screwed pipe shall be made up with pipe joint compound applied to male threads only. Taping of joints will not be permitted. Threads shall be cut straight and true with all sections reamed and cleaned before installation.
2. All black steel pipe 2" and smaller shall be assembled with heavy boss, cast iron or malleable screwed fittings.

B. Welded Connections:

1. All joints in welded piping shall be assembled by fusion welding using factory-made welding

fittings. Pipe shall be reamed and cleaned before erection. Weld-O-Lets or Thread-O-Lets may be used where the branch line is at least two sizes smaller than the main line as hereinbefore specified.

2. All welding shall be done by competent welders in a first-class, workmanlike manner. No welding operator shall be permitted to weld unless he has proved satisfactory experience and/or certified as having fully complied with acceptable qualification tests. When a welder has been approved, he shall not be removed without permission of Architect.
3. Certification shall indicate that each welder has passed a qualification test as prescribed by National Certified Pipe Welding Bureau, or by other reputable testing laboratories or agencies, using procedures approved by the American Society of Mechanical Engineers or the American Welding Society.
4. The abutting ends of all pipe and welding fittings shall be accurately beveled at an angle of 45° to within 1/16" plus or minus 1/32" of inside pipe wall. All surfaces beveled by the cutting torch shall be properly cleaned of all oxide and unnecessary roughness by grinding, filing or other suitable means.
5. Low carbon steel welding rods shall develop a tensile strength of not less than 45,000 PSI cross-section of the metal deposited in the weld. Special and eutectic steel welding rods of good weldability and having a tensile strength greater than 45,000 psi may be used.
6. All circumferential welds shall have a width to 2-1/2 times pipe wall thickness and shall be reinforced approximately 1/16" above outside of pipe wall. Fusion shall extend through entire pipe wall to the outside. Projection of fused metal on inside of pipe must be avoided. There shall be no valley, either at edge or at center of the joint, and weld shall be built up with multiple passes so that weld metal will present a gradual increase in thickness from outside surface of pipe to the center of the weld.
7. Weld neck flanges shall be employed where welded pipe is joined to flanged valves and equipment.
8. Welding procedure shall conform to recommendations of the ANSI Code for Pressure Piping. Gas welding will be acceptable.

C. Flanged Connections:

1. Flanged joints at valves, unions, equipment, etc., shall be made up with machine bolts and factory-made ring gaskets similar to Garlock, and of materials recommended for the various services. Flanges shall conform to ANSI B16.5.

D. Solder Connections:

1. All joints in copper tubing shall be made up with 95-5 tin-antimony solder. Ends of pipe and fittings shall be cleaned and burnished before solder is applied.

E. Mechanical Crimping Connections:

1. For copper circulating water piping and cold water make-up piping of all sizes, the Viega ProPress System of mechanical joint copper tubing assembly shall be acceptable. The ProPress System shall consist of an electro-hydraulic pressure crimping tool, with sets of interchangeable crimping jaws, and ProPress special copper fittings. The fittings shall include an O-sealing ring, and shall require no torches, solders, flux, or special pipe burnishings or preparation. A permanent, watertight seal is made by crimping the fittings. Rated at 200 PSI; tested to 600 PSI. The systems shall be installed in accordance with manufacturer's installation instructions and governing code requirements. Pipe supports shall be installed so that interior horizontal piping is in uniform alignment.
2. The use of the ProPress System for tubing assembly is only acceptable when installed by tradespeople specifically trained in this type of assembly.

2.6 MECHANICAL GROOVED PIPE COUPLINGS

A. The HVAC Contractor shall be permitted to furnish and install mechanical grooved pipe couplings in lieu of welded fittings and flanges on the following steel piping systems:

1. Circulating Water Piping

B. Acceptable Manufacturers:

1. Victaulic (Basis of Design)
2. Tyco Grinnell
3. Anvil Gruvlok

C. All grooved couplings, and fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

D. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

E. Mechanical pipe couplings are not permitted in inaccessible spaces such as above plaster ceilings and piping and ductwork shafts unless approved by the Architect.

F. Pipe shall be of type herein specified, except pipe shall be square-cut or roll grooved to the coupling manufacturer's specifications. The pipe couplings shall be as manufactured by the Victaulic Company of America, or approved equal, and shall be suitable for the type of service intended. Couplings and gaskets shall have a temperature range of -30 degrees F. to +230 degrees F. The couplings shall be installed in a manner which will provide for expansion and contraction of the systems without leakage, in strict accordance with the coupling manufacturer's details, published literature and instruction.

G. Victaulic Installation-Ready Couplings Style 107H/107N (rigid) and 177 & 77 (flexible):

1. 2” through 12”: Rigid type, coupling housings with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ANSI B3.1, B31.9. Couplings shall be installation ready, for direct stab installation without field disassembly. Gasket shall be Grade “EHP” EPDM compound with red color code designed for operating temperatures from -30 deg F to +250 deg F. Victaulic Style 107H/107N.
2. 2” through 8”: Flexible type, for use in locations where vibration attenuation and stress relief are required. Couplings shall be installation ready, for direct stab installation without field disassembly. Gasket shall be Grade “EHP” EPDM compound with red color code designed for operating temperatures from -30 deg F to +250 deg F. Victaulic Style 177.
3. 10” through 12”: Victaulic Style 77 standard flexible coupling with Grade “E” EPDM gasket with green color code for water services from -30 deg F to +230 deg F.

H. Victaulic AGS Series Fittings, Style W07 Rigid Coupling, and Style W77 Flexible Coupling:

1. AGS grooved ends, for use with Victaulic W07 or W77 couplings and W741 flange adapter. Fittings shall be manufactured of ductile iron conforming to ASTM A-536, factory-fabricated from carbon steel pipe conforming to ASTM A-53. Fittings shall be manufactured to the dimensional standards ASME B16.9. Orange enamel coated or galvanized.
2. AGS Couplings shall consist of two ASTM A-536 ductile iron housing segments, a wide-width elastomer pressure responsive FlushSeal® gasket, and zinc electroplated carbon steel track head bolts and nuts conforming to the physical and chemical requirements of ASTM A-449 and the physical requirements of ASTM A-183. Housings include lead-in chamfer on the housing key.

    a. Victaulic W07 AGS Rigid Coupling: Coupling key shall be designed to fill the wedge shaped AGS groove to provide a rigid joint that corresponds with support spacings

as defined by ASME B31.1 and B31.9. Systems incorporating rigid couplings require the calculated thermal growth/contraction of the piping system to be fully compensated for in the design of the piping system through use of adequate flexible components.

b. Victaulic W77 AGS Flexible Coupling: Coupling key shall be designed to fit into the wedge shaped AGS groove and allow for linear and angular movement, vibration attenuation, and stress relief

I. Flange adapters shall be suitable for direct connection to Class 125 or 150 flanged components, with ductile iron housings, and pressure responsive gaskets. Victaulic Style 741 / W741.

J. For use with copper tubing 2” and larger sizes, Victaulic Copper-Connection fittings conforming to ASME B16.22 and ASME B16.18, with Style 607H installation-ready coupling with offsetting angle-pattern bolt pads and grade EHP gasket for water service to +250 degrees F.

1. The system shall be manufactured to copper-tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.)

K. Gasket Elastomers shall have properties designated by ASTM D-2000. Gasket shall be of the mechanical grooved coupling design, pressure responsive so that internal water pressure serves to increase the seal's water tightness. Gasket supplied shall be EPDM-HP Grade EHP with red and green color code for water service to 250 degrees F and EPDM Grade "E" with green color code identification and conform with ASTM D-2000 designation 2CA615 A25B442 with maximum tensile change as published by the manufacturer for water service to 230 degrees F.

L. Bolts and nuts shall be heat-treated carbon steel conforming to physical properties of ASTM A183 and A449, minimum tensile 110,000 psi. The coupling segments shall be assembled with two or more oval neck track bolts. The nuts shall be tightened to assure firm metal-to-metal contact of the coupling bolt pads.

M. Grooved joints shall be installed in accordance with the manufacturer’s latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service.

N. The Contractor shall obtain the services of the coupling manufacturer's qualified representative as required to obtain all instructions and details for a complete supervised installation.

O. The representative (direct employee) of the mechanical joint manufacture shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed.

P. Contractor shall remove and replace any improperly installed products.

Q. A distributor’s representative is not considered qualified to conduct the training.

R. The Heating Contractor will be responsible for the installation complete in every detail.

S. All insulation installations and other installation revisions will be the responsibility of the Heating Contractor. All mechanical pipe couplings shall be insulated with Zeston, Knauf, or approved equal, prefabricated fitting covers designed specifically for mechanical couplings. Valves, cocks, and other piping system accessories shall be revised as required to accommodate the coupling installation. The installation must conform with all applicable codes.

T. Sufficient hangers must be installed as required for complete substantial installations.

U. The entire installation shall be free of stress. For water systems, Victaulic flexible couplings may be used to accommodate thermal growth, contraction, and for the elimination of expansion loops. (In accordance with the manufacturer's written recommendations.) Where loops are required, use flexible couplings on the loop.

V. Three Victaulic flexible couplings may be used in lieu of flexible connectors for vibration attenuation. The couplings shall be placed in close proximity to the source of the vibration.

PART 3 – EXECUTION

3.1 PIPING SYSTEM INSTALLATIONS

A. All piping installations shall be in accordance with American Code for Pressure Piping No. ANSI B31.1. All piping not specifically mentioned herein shall be installed per the manufacturer's recommendations and applicable recognized codes.

B. All piping and system accessories shall be stored with ends closed tight.

C. Before installation, each length of pipe, each fitting and each accessory (such as a valve) shall be "bore-sighted", inspected and cleaned if debris or dirt is found.

D. After installation of piping, but before valves and accessories are installed, a heavy wad of swabbing cloth shall be pulled through the piping and fittings. All loose scale or debris shall be blown or worked free and removed.

E. After closure, each system shall be flushed clean as herein specified under "Cleaning." Connections shall be installed for this purpose, and all necessary temporary piping shall be furnished, installed and removed after system is approved. The Contractor shall double-check to see that items such as rocks, stones, mud, wood and other debris are not left in the system.

F. Equipment such as tanks shall be cleaned in the same manner but the procedure shall be varied to suit the specific item being cleaned. Coils shall be absolutely clean inside and outside before closure and after use for temporary heat, etc.

G. All pipes shall be cut accurately to measurements established at the Building and shall be worked into place without springing or forcing, properly clearing all Building openings. Excessive cutting or other weakening of the Building structure to facilitate piping installation will not be permitted. Threaded pipe shall have full, clean-cut threads. All pipes shall have burrs removed by reaming. All pipes shall be so installed as to provide proper drainage and to permit free expansion and contraction without causing damage. All changes in directions shall be made with fittings.

H. The ends of piping and associated equipment shall be capped or plugged as construction proceeds to prevent the entrance of dust, dirt, and other foreign matter.

I. Valves shall be so placed that automatic valves, check valves and equipment may be entirely isolated for repairs while the system is in operation.

J. All piping run within the Building shall be run concealed in the finished portions of the Building, in pipe spaces, furred ceilings or furred chases and exposed only in unfinished areas, Mechanical Rooms, or specifically where shown on the Drawings. The Heating Contractor shall locate all necessary chases or openings in new construction that are to be provided by the General Contractor. No piping shall be run exposed in finished areas of the Building without the consent and approval of the Architect for each specific installation.

K. All piping shall be hydrostatically or air tested to 150 PSIG, or 1.5 times the design pressure, whichever is higher, for a period of two hours. During this period all welds, joints, etc., shall be coated with soap emulsion to test for leaks, which shall be made tight and free from imperfections. Piping joints shall not be insulated until they have been pressure tested and are free of leaks.

L. All piping shall be cleaned, filled and vented of all air as herein specified.

M. Due to the small scale of the Drawings, it is not possible to indicate all offsets, fittings, valves or similar items which may be required to make a complete operating system. The Drawings are generally diagrammatic and indicative of the work to be installed. The Heating Contractor shall carefully investigate all conditions affecting his work and shall install his work in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features will be avoided, and shall furnish and install all such offsets or fittings as may be required to meet the conditions at the Building, so as to avoid such interferences without additional cost to the Client Agency.

N. Each installation shall be made in a workmanlike manner, according to the best practice of the trade, properly installed and vented to eliminate air pockets or traps and to insure rapid and noiseless circulation throughout.

O. All pipe work shall run parallel with, or at right angles to Building walls and partitions, and all exposed connections, risers or other piping in such areas shall be erected plumb and straight so as to form parallel lines with walls and floors. These requirements refer to long and short runs alike. Piping shall not be run exposed in finished areas unless specifically shown and prior approval is obtained from the Architect.

P. Each section of pipe shall be reamed and cleaned before installation. All steel piping 2-1/2" and larger shall be assembled with welded connections. Seamless forged welding fittings of same material as pipe shall be used for all connections, except Weld-O-Lets or Thread-O-Lets may be used where branch line is at least two sizes smaller than main line.

Q. Welds shall be painted with a primer coat of Rustoleum immediately after metal brush cleaning and the pipe cools.

END OF SECTION 23 2113

SECTION 23 2213 – STEAM AND STEAM CONDENSATE PIPING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SCOPE

A. The pipe and fittings for the various HVAC systems shall be as hereinafter described in this section.

B. This specification includes steam and condensate piping for above ground and tunnel service.

1.4 APPLICABLE CODES

A. Work performed, and material supplied under this Section shall be in accordance with the latest addenda thereto of the applicable codes, standards, specifications, regulations, procedures, and tests cited herein.

B. The Work shall be in accordance with the latest edition and revisions of the following Codes and Standards where applicable.

1. American Society of Mechanical Engineers (ASME).
2. American Society for Testing and Materials (ASTM).
3. American National Standards Institute (ANSI).

C. If there is any overlapping of, or conflict between, the requirements of these codes and this specification, then the requirement which is most stringent shall take precedence.

1.5 SUBMITTALS

A. Product Data:

1. Include data on pipe materials, pipe fittings, and accessories.

B. Record Documents:

1. Include welder’s certification of compliance with ANSI/AWS D10.12 and ANSI/ASME B31.1.
2. Submittal data for all fittings and flanges shall include a letter signed by an official of the manufacturing company certifying compliance with these Specifications.

C. Shop Drawings:

1. Provide dimensioned shop drawings, drawn to scale, indicating pipe service, sizes, and routing, types and spacing of supports and hangers, locations of anchors, guides,

expansion compensators, expansion loops, valves, and drip legs.

2. Shop drawings shall consider the existing field conditions and interferences of existing utilities in tunnels and other facilities along the route of the piping to be installed.

D. As-Built Drawings:

1. The Contractor shall submit revised shop drawings reflecting the as-built conditions at the conclusion of the work via e-Builder.
2. As-built shop drawings shall be furnished in the form of PDF and other electronic file forms which may be specified by the Professional.
3. Submit as-built shop drawings to both the Client Agency and the Professional via e-Builder.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Steam and Condensate piping shall include the following:

1. High Pressure Supply and Return (HPS & R)
2. Medium Pressure Supply and Return (MPS & R)
3. Low Pressure Return (LPR)
4. Pump Discharge Condensate (PD)
5. Boiler Feedwater (BFW)
6. Drain piping
7. Relief valve piping
8. Vent Piping

B. The piping systems shall meet the requirements of the International Mechanical Code, latest edition.

2.2 STEAM PIPING

A. High Pressure Steam (HPS) Piping (100 PSIG to 200 PSIG):

1. For pipe sizes 2" and smaller:

a. Pipe shall be Schedule 40 steel seamless meeting ASTM A106, Grade B.
b. Fittings shall be 300 PSIG with threaded joints. In steam tunnels the fittings shall be malleable 2000 pound forged steel meeting ASME B16.11 with welded joints.
c. Pipe and fittings shall be joined via socket welding.

2. For pipe sizes 2-1/2" and larger:

a. Pipe shall be Schedule 40 steel Type E meeting ASTM A106, Grade B.
b. Fittings shall be standard weight wrought steel meeting ASME B16.9 or B16.28.
c. Pipe and fittings shall be butt welded and flanged joints.

B. Low Pressure Steam (LPS) (up to 15 PSIG), and Medium Pressure Steam (MPS) (up to 100 PSIG) Piping:

1. For pipe sizes 2" and smaller:

a. Pipe shall be Schedule 40 steel seamless meeting ASTM 106 Grade B.
b. Fittings shall be class 125 cast iron or 150 PSIG malleable iron with threaded joints.

2. For pipe sizes 2-1/2" and larger:

a. Pipe shall be Schedule 40 steel Type E meeting ASTM A106, Grade B.
b. Fittings shall be standard weight wrought steel meeting ASME B16.9 or B16.28.
c. Pipe and fittings shall be butt welded, mechanically joined using Victaulic Style 870 couplings or shall have flanged joints.

2.3 STEAM CONDENSATE PIPING

A. High (HPR) and Medium (MPR) Pressure Steam Condensate Return Piping:

1. For pipe sizes 2" and smaller:

a. Pipe shall be Schedule 80 steel Type S meeting ASTM A106, Grade B.
b. Fittings shall be extra heavy duty wrought steel meeting ASME B16.9, ASME B16.28 or ASTM A420.
c. Pipe and fittings shall be joined via socket welding for below ground service and in steam tunnel service.

2. For pipe sizes 2-1/2" and larger:

a. Pipe shall be Schedule 80 steel Type E meeting ASTM A53 or A106, Grade B.
b. Fittings shall be extra heavy duty wrought steel meeting ASME B16.9, ASME B16.28 or ASTM A420.
c. Pipe and fittings shall be butt welded.

B. Low Pressure Steam Condensate Return (LPR) and Pumped Discharge Condensate Return (PD) Piping:

1. For pipe sizes 2" and smaller:

a. Pipe shall be Schedule 80 steel Type S meeting ASTM A53, Grade B.
b. Fittings shall be 300 PSIG malleable iron with threaded joints meeting ASME B16.3 for aboveground service and shall be forged steel meeting ASME B16.11 for tunnel service.
c. Pipe and fittings shall be joined via socket welding for steam tunnel service.

2. For pipe sizes 2-1/2" and larger:

a. Pipe shall be Schedule 80 steel Type E meeting ASTM A53 or A106, Grade B.
b. Fittings shall be extra heavy duty wrought steel meeting ASME B16.9, ASME B16.28 or ASTM A420.
c. Pipe and fittings shall be butt welded, mechanically joined using Victaulic Style 870 couplings or shall have flanged joints.

2.4 RELATED STEAM SYSTEM PIPING

A. Boiler Feedwater (BFW) Piping:

1. Boiler feedwater piping on High Pressure Steam systems shall be as that specified for HPR piping.
2. Boiler feedwater piping on Low Pressure Steam systems and Medium Pressure Steam systems and shall be the same as that specified for MPR and LPR piping.

B. Pumped Discharge Condensate Return Piping:

1. Pumped discharge condensate return (PD) piping shall be the same as that specified for Low Pressure Condensate Return (LPR) piping.

C. Drain Piping:

1. Drain piping on High Pressure Steam (HPS) systems, downstream of the shutoff valve, shall be the same as that specified for HPS piping.
2. Drain piping on Low Pressure Steam (LPS) systems and Medium Pressure Steam (MPS) systems, downstream of the shutoff valve, shall be the same as that specified for LPS and MPS piping.

D. Relief Valve Piping:

1. Relief valve piping on High Pressure Steam (HPS) systems, downstream of the relief valve, shall be the same as that specified for HPS piping.
2. Relief valve piping on Low Pressure Steam (LPS) and Medium Pressure Steam (MPS) systems, downstream of the relief valve, shall be the same as that specified for LPS and MPS piping.

E. Vent Piping:

1. Vent piping on High Pressure Steam (HPS) systems shall be the same as that specified for HPS piping.
2. Vent piping on Low Pressure Steam (LPS) systems and Medium Pressure Steam (MPS) systems shall be the same as that specified for LPS and MPS piping.

2.5 STEAM UNIONS

A. Materials for unions shall match the pipe system category for pressure, temperature, and corrosion.

B. Unions for steam piping shall be:

1. Steel - Threaded, Class 300, ASME B16.39, malleable iron seat.

C. Dielectric unions shall separate all ferrous and nonferrous metals in every piping system. Unions shall match those above, except that metal-to-metal contact is to be avoided. Where flanges are used, the bolts shall be insulated from the body of the flange.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. Piping installations shall be in accordance with ANSI/ASME B31.1 Power Piping. Piping not specifically mentioned herein shall be installed per the manufacturer's recommendations and applicable recognized codes.

B. The drawings are generally diagrammatic and indicative of the work to be installed. Due to the small scale of the drawings, it is not possible to indicate each offset, fitting, valve or similar items which may be required to make a complete operating system.

C. The Contractor shall carefully investigate the conditions affecting his work and shall install his work in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features are avoided.

D. The Contractor shall furnish and install offsets or fittings as necessary to avoid interferences and

obstructions without additional cost to the Client Agency.

E. Piping work shall be coordinated with each trade involved.

F. Piping shall be installed overhead and tight to the underside of the structure or deck. With space for insulation, unless noted otherwise.

G. Install piping so that valves, strainers, unions, traps, flanges and other appurtenances requiring access are accessible.

H. Each valve shall be installed so that the valve remains in service when equipment or piping on the equipment side of the valve is removed.

I. Unions and/or flanges shall be installed at each piece of equipment, in by-passes, and in long piping runs (100 feet or more) to permit disassembly for alterations and repairs.

J. Slope steam piping downward in the direction of flow ¼ inch per 10 feet (1 inch per 40 feet) minimum.

K. Slope steam return lines downward in the direction of condensate flow ½ inch per 10 feet (1 inch per 20 feet) minimum.

L. Where the length of the branch pipe is less than eight (8) feet long, slope branch lines ½ inch per foot minimum.

M. Provide an end of main drip at each rise in the steam main.

N. Provide condensate drips at the bottom of steam risers, down fed runouts to equipment, radiators, etc. at the end of mains and low points, and ahead of pressure regulators, control valves, isolation valves and expansion joints.

O. On straight steam piping runs with no natural drainage points, install drip legs at intervals not exceeding 200 feet where the pipe is sloped downward in the direction of steam flow and a maximum of 100 feet where the pipe is sloped upward so that the condensate flow direction is opposite of the steam flow.

P. Install pipes without forcing or springing.

3.2 STORAGE AND CLEANING

A. Piping and system accessories shall be stored with ends closed tight.

B. Before installation, each length of pipe, each fitting and each accessory (such as a valve) shall be "bore-sighted", inspected and cleaned if debris or dirt is found.

C. The Contractor shall verify that items such as rocks, stones, mud, wood and other debris are not left in the system.

D. Each section of pipe shall be reamed and cleaned before installation.

E. After installation of piping, but before valves and accessories are installed, a heavy wad of swabbing cloth shall be pulled through the piping and fittings. Loose scale or debris shall be blown or worked free and removed.

F. Equipment such as tanks shall be cleaned in the same manner, but the procedure shall be varied to suit the specific item being cleaned.

G. After closure, each system shall be flushed clean. Refer to Section 23 0506, Paragraph 3.1. Connections shall be installed for this purpose, and the necessary temporary piping shall be furnished, installed and removed after system is approved.

H. Coils shall be cleaned inside and outside before closure and after use for temporary heat, etc.

3.3 PIPING SYSTEM INSTALLATIONS

A. Each installation shall be made in a workmanlike manner, according to the best practice of the trade, and properly installed.

B. Pipes shall be cut accurately to measurements established at the Building and shall be placed without springing or forcing, properly clearing each Building opening. Excessive cutting or other weakening of the Building structure to facilitate piping installation will not be permitted.

C. Piping installed within the Building shall be concealed in the finished portions of the Building, in pipe spaces, furred ceilings or furred chases and exposed only in unfinished areas, Mechanical Rooms, or specifically where shown on the Drawings.

D. Install piping parallel with, or at right angles to Building walls and partitions. Exposed connections, risers or other piping shall be erected plumb and straight to form parallel lines with walls and floors. These requirements refer to long and short runs alike.

E. The Contractor shall locate each necessary chase or opening in new construction that will be provided by the General Contractor.

F. No piping shall be exposed in finished areas of the Building without the consent and approval of the Professional for each specific installation.

G. Threaded pipe shall have full, clean-cut threads. Pipes shall have burrs removed by reaming.

H. Steel piping 2-1/2" and larger shall be assembled with welded connections. Seamless forged welding fittings of same material as pipe shall be used for connections, except Weld-O-Lets or Thread-O-Lets may be used where branch line is at least two sizes smaller than main line.

I. Install pipes to permit their proper drainage and free expansion and contraction without causing damage. Each change in direction shall be made with fittings.

J. The ends of piping and associated equipment shall be capped or plugged as construction proceeds to prevent the entrance of dust, dirt, and other foreign matter.

K. Install valves such that automatic valves, check valves and equipment may be entirely isolated for repairs while the system is in operation.

L. Welds shall be painted with a primer coat of Rustoleum immediately after metal brush cleaning and the pipe cools.

3.4 INSPECTIONS AND TESTING

A. Piping shall be hydrostatically, or air tested to 150 PSIG, or 1.5 times the design pressure, whichever is higher, for a period of two hours.

B. During this period each weld, joint, etc., shall be coated with soap emulsion to test for leaks,

which shall be made tight and free from imperfections.

C. Piping joints shall not be insulated until they have been pressure tested and are free of leaks.

3.5 LOW PRESSURE CONDENSATE RETURN PIPING (LPR)

A. Low pressure condensate return piping (LPR) downstream of steam traps shall drain by gravity. At no time shall the piping rise in elevation such that the pressure of the steam (15 PSIG and less), upstream of the steam trap, be relied upon to drain, or propel the condensate.

B. LPR piping shall exit the steam traps, turn downward through the floor and extend through the space below to the intended LPR pipe riser indicated on the drawings, as necessary, to comply with the gravity drain requirement.

C. The purpose of these requirements is to prevent instances of flooded steam coils in all heating equipment. In particular, the flooding of air handling unit steam coils must be prevented because the condensate might freeze and result in a ruptured steam coil. Additionally, lifting or propelling condensate with steam pressure may result in damaging water hammer incidents.

END OF SECTION 23 2213

SECTION 23 2216 – STEAM VALVES, TRAPS, AND SPECIALTIES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SCOPE

A. The steam system equipment shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.1 VALVES AND ACCESSORIES – STEAM SERVICE

A. Steam service shall include the following:

1. High Pressure Supply and Return (HPS & R)
2. Medium Pressure Supply and Return (MPS & R)
3. Low Pressure Supply and Return (LPS & R)
4. Pumped Condensate (PC)
5. Boiler Feedwater (BFW)
6. Associated drain, relief and vent piping

B. General Requirements:

1. Furnish and install valves necessary to the proper operation of the system.
2. A valve shall be placed where each branch leaves the main and at such points as required for the proper control and shut-off of each line.
3. Each piece of equipment that may have to be removed from the system for repair shall be connected by union or flange and provided with isolation valves.
4. Valves located more than seven feet (7'-0") above the floor or other inaccessible elevated locations, shall be provided with chain wheel with hammer-blow operator.
5. Materials for small valves shall be bronze and for larger valves shall be cast iron, cast ductile iron or cast steel, as required for the pressure and service of the valve and as listed below.
6. Bronze valves, including bronze check valves, shall be made to be "dezincification resistant", with metal components in the waterway not containing more than 15% zinc in their chemical makeup.
7. Manufacturers for gate, globe and check valves: NIBCO, Inc., Milwaukee Valve Co., Inc., Crane Co., or equal as approved by the professional.

C. Low Pressure Valves (0-15 PSIG):

1. Low pressure valves for steam service shall be minimum Class 125 and shall be as follows:
2. Gate Valves:

a. Gate valves, 2” and smaller, for shut-off service shall be bronze, Class 150, rising stem, union bonnet, solid wedge, threaded ends, or approved equivalent valves with non-rising stem will be acceptable. Valves shall conform to MSS SP-80. Split wedge valves will be acceptable.
b. Gate valves, 2½” and larger, for shut-off service shall be Class 125, 100 PSI (Saturated Steam to 338°F) cast iron body, bronze mounted, rising stem, bolted bonnet, solid wedge, OS&Y, flanged, or threaded, or approved equivalent. Valves shall conform to MSS SP-70

3. Ball Valves:

a. Ball valves, 2” and smaller, 150 PSI and 600 CWP, for shut-off service shall be bronze, two-piece body, full port, SS trim, threaded ends. Valves shall conform to MSS SP-110.
b. Fast-opening valves, 2” and smaller, for drains, blow-offs, etc. shall be bronze, two-piece body, full port, SS trim, threaded ends. Valves shall conform to MSS SP-110.

4. Butterfly Valves:

a. Butterfly valves shall be furnished and installed on steam lines 2½" and larger.
b. Valves shall be guaranteed for Class VI.
c. Valves shall be ANSI Class 150 complete with soft-seated PTFE (480°F) stem seals, 316 stainless steel bearings for anti-galling, 316 stainless steel offset discs, reinforced PTFE disc seats suitable for 480°F service, lug type carbon steel body, and 316 stainless steel stem.
d. Butterfly valves shall be lug style, as manufactured by DeZurik, Crane, Jamesbury, Bray, NIBCO or equal as approved by the professional.
e. Bodies shall be furnished with tapped lugs and flange bolts to allow downstream piping to be disconnected leaving the valve in line to control the flow.
f. Butterfly valves 4" and smaller shall be furnished with a hand lever operator.
g. Butterfly valves 6" and larger shall be furnished with a quarter turn gear operator with hand wheel.
h. Each valve shall be furnished with a disc position/over-travel indicator to provide visual indication of disc position and to simplify actuator adjustment.
i. Valves shall be installed with stems above the horizontal and with hand-wheels positioned for easy operation.

5. Globe Valves:

a. Globe valves 2” and smaller for throttling service shall be bronze body, Class 125, straight through or angle type, screw-in bonnet, PTFE disc, integral seat, and renewable seat and disc, (straight), or (angle), or approved equivalent, threaded ends. Valves shall conform to MSS SP-80.

6. Check Valves:

a. Check valves, 2” and smaller, shall be Class 125, horizontal swing, regrinding type, Y-pattern, renewable seat and disc, threaded ends. Valves shall conform to MSS SP-80.
b. Check valves, 2½” and larger, shall be Class 125, 125 PSI (Saturated steam to 353°F) cast iron body, brass trim, with bronze disc, bolted bonnet, horizontal swing, renewable seat and disc, (flanged), or approved equivalent. Valves shall conform to MSS SP-71, Type 1.

D. Medium Pressure Valves (16 - 100 PSIG):

1. Gate Valves:

a. Gate valves, 2” and smaller, for shut-off service shall be bronze, Class 200, rising stem, block pattern, union bonnet, rising stem, solid wedge, threaded ends. Valves shall conform to MSS SP-80.
b. Gate valves, 2½” and larger, for shut-off service shall be Class 250, 250 PSI (Saturated Steam 406°F), ductile iron body with bronze trim, rising stem, bolted bonnet, solid wedge, raised face flanges, OS&Y. Valves shall conform to MSS SP-70.

2. Ball Valves:

a. Ball valves, 2” and smaller, for shut-off service, shall be bronze, Class 250 steam rating, full port, 316 SS trim, carbon filled PTFE seats, blowout proof stem, vented ball. Valves shall conform to MSS SP-110.

3. Butterfly Valves:

a. Butterfly valves shall be furnished and installed on steam lines 2½" and larger.
b. Valves shall be guaranteed for Class VI.
c. Valves shall be ANSI Class 150 complete with soft-seated PTFE (480°F) stem seals, 317 stainless steel bearings for anti-galling, 316 stainless steel discs, reinforced PTFE disc seats suitable for 480°F service, lug type carbon steel body, and 316 stainless steel stem.
d. Butterfly valves shall be lug style, as manufactured by DeZurik, Crane, Jamesbury, Bray, NIBCO, or equal as approved by the professional.
e. Bodies shall be furnished with tapped lugs and flange bolts to allow downstream piping to be disconnected leaving the valve in line to control the flow.
f. Butterfly valves 4" and smaller shall be furnished with a hand lever operator.
g. Butterfly valves 6" and larger shall be furnished with a quarter turn gear operator with hand wheel.
h. Each valve shall be furnished with a disc position/over-travel indicator to provide visual indication of disc position and to simplify actuator adjustment.
i. Valves shall be installed with stems above the horizontal and with hand-wheels positioned for easy operation.

4. Globe Valves:

a. Globe valves, 2” and smaller, for throttling service shall be bronze, Class 200, straight through, union bonnet, replaceable seat, and full plug disc, threaded ends. Valves shall conform to MSS SP-80. Angle valves will be acceptable.
b. Globe Valves, 2½” and larger, for throttling service, shall be cast iron body, Class 250, 250 PSI (Saturated Steam to 406°F), bolted bonnet, renewable seat and disc, bronze mounted. Valves shall conform to MSS SP-85.

5. Check Valves:

a. Check valves, 2” and smaller, shall be Class 200, bronze body, horizontal swing, regrinding type, Y-pattern, renewable seat and disc, threaded ends. Valves shall conform to MSS SP-80.
b. Check valves, 2½” to 6” size, shall be Class 250, 250 PSI (Saturated Steam to 406°F), cast iron body, horizontal swing, renewable bronze seat and disc, bolted bonnet, (flanged), or approved equivalent. Valves shall conform to MSS SP-71, Type 1.

E. High Pressure Steam Valves (100 – 200 PSIG):

1. Gate Valves:

a. Gate valves 2” and smaller, for shut-off service, shall be Class 300, 300 PSI (Saturated Steam to 406°F), shall be bronze body, rising stem, union bonnet, alloy solid wedge, SS seats. Valves shall conform to MSS SP-80.
b. Gate valves, 2½” and larger, for shut-off service, shall be Class 250, 250 PSI (Saturated Steam to 406°F), shall be iron body, bronze mounted, rising stem, bolted bonnet, OS&Y, solid wedge, flanged ends. Valves shall conform to MSS SP-70.

2. Ball Valves: Not Acceptable.
3. Triple Offset Rotary (Butterfly) Valves:

a. Acceptable Manufacturers:

1) Adams – MAK Series (Basis of Design)
2) Vanessa – Series 30,000
3) Zwick – Tri-Con Series
4) Bray – TriLok Series

b. Butterfly valves shall be furnished and installed on steam lines 3" and larger.
c. Valves shall be quarter turn, bi-directional, guaranteed for zero leakage performance in compliance with API 598 and API6D, and shall be complete with manual handle and position indicator.
d. Valves shall be ANSI Class 300, triple offset with inclined conical seating surfaces, complete with graphite stem packing, 316 stainless steel bearings, 316 stainless steel discs, Stellite GR. 2.1 weld overlay body seat, UNS31803 (Duplex) + Graphite seal ring, lug type ASTM A216 WCB carbon steel body, and ASTM 182 F6a shaft.
e. Packing gland must be secured with 4 bolts.
f. Valves shall be furnished with extended stems to accommodate insulation.
g. Bodies shall be furnished with tapped lugs and flange bolts to allow downstream piping to be disconnected leaving the valve in line to control the flow.
h. Butterfly valves 4" and smaller shall be furnished with a hand lever operator.
i. Butterfly valves 6" and larger shall be furnished with a right angle, quarter turn gear operator with hand wheel.
j. Each valve shall be furnished with a disc position/over-travel indicator to provide visual indication of disc position and to simplify actuator adjustment.
k. Valves shall be installed with stems above the horizontal and with hand-wheels positioned for easy operation.
l. Valve bodies and operators shall be factory coated with epoxy.

5. Globe Valves:

a. Globe valves, 2” and smaller, for throttling service shall be bronze, Class 300, straight through or angle type, union bonnet, replaceable seat, and full plug disc, (straight), or (angle), or approved equivalent, threaded ends. Valves shall conform to MSS SP-80.
b. Globe Valves, 2½” and larger, for throttling service, shall be cast iron body, Class 250, 250 PSI (Saturated Steam to 406°F), bolted bonnet, renewable seat and disc, bronze mounted. Valves shall conform to MSS SP-85.

6. Check Valves:

a. Check valves, 2” and smaller, shall be Class 300, bronze body, horizontal swing, regrinding type, Y-pattern, renewable seat and disc, threaded ends. Valves shall conform to MSS SP-80.
b. Check valves, 2½” and larger, for pressures up to 250 PSI to 6” size, shall be Class 250, cast iron body, horizontal swing, renewable bronze seat and disc, bolted bonnet, NIBCO F-968-B (flanged), or approved equivalent. Valves shall conform to MSS SP-

71, Type 1.

F. Stop Check Valves:

1. Stop check valves shall be cast iron body, Class 250, 250 PSI (Saturated Steam to 406°F), angle pattern, renewable seat and disc, bolted bonnet, (flanged), or approved equal. Valves shall conform to MSS-SP-85.

G. Safety Relief Valves:

1. Safety relief valves shall be installed on steam piping as required by local regulatory agencies having jurisdiction.
2. Safety relief valves shall serve the dual purpose of relieving over-pressure created by thermal expansion and over-pressure in the form of steam.
3. Safety relief valves shall be ASME rated and shall be like Kunkle Model 300, Spirax-Sarco, Kunkle Model 300, Spirax-Sarco, Watts Conbraco, or approved equivalent.
4. Discharge of drip pan elbows shall be piped to funnel drains or floor drains.
5. All safety relief valves shall be ASME approved and certified by the National Board of Boiler and Pressure Vessel Inspectors and shall bear approval stamps, along with pressure and capacity data.

H. Steam Strainers:

1. Full size of piping, Series 400 as manufactured by Hoffman, Spirax-Sarco, or Armstrong with 20 mesh stainless steel screen.
2. Each strainer shall be fitted with blow down valve, full size of connection.
3. High pressure strainers shall be iron ASTM A116 Grade B or bronze ASTM B-62 body.

2.2 STEAM TRAPS

A. Steam trap sizes and types shall be as noted on the plans.

1. Acceptable Manufacturers:

a. Spirax-Sarco (Models as listed below)
b. Armstrong
c. Hoffman
d. Watson McDaniel
e. TLV

B. General Requirements:

1. The manufacturer shall verify suitability of trap selected to operate under design conditions.
2. Steam traps shall be no less than ¾ inch size.
3. Traps shall be installed complete with accessories such as strainers, isolation valves, etc., as shown on the plans.
4. Furnish and install float and thermostatic traps at each drip point on the low and high pressure steam mains, as shown on the drawings, or required, and at other locations shown.
5. Traps shall also be furnished and installed at equipment furnished under this contract and at equipment furnished under other contracts.
6. Traps at end of line drip points shall be equipped with proper sized orifices to have a continuous capacity of 660 lbs./hr. of condensate with a pressure differential of 70 PSI; 550 lbs./hr. of condensate with a pressure differential of 40 PSI; and 690 lbs./hr. of condensate with a pressure differential of 20 PSI.

C. Float and Thermostatic Traps:

1. Float and thermostatic steam traps for process, heating or drips to 200 PSI shall have ductile or class 30 cast iron bodies with removable cover so that traps can be repaired without disturbing the piping.
2. Internal components including the float, main valve head/seat, thermostatic air vent, and air vent head and seat shall be stainless steel.
3. Air vent shall be precision welded twin diaphragm of self-adjusting, balanced pressure type, which is completely encased in a protective capsule.
4. The air vents shall offer high resistance to water hammer and be suitable for 45 ºF of superheated steam.
5. Float and thermostatic traps for drip and equipment applications shall have either inline or parallel connections.
6. Float and thermostatic traps shall be Spirax-Sarco Model FTI, FT, FTB.
7. High pressure float and thermostatic traps for process and drip service to 465 PSIG shall have the same specifications except bodies shall be steel with a rating of 465 PSIG and connections shall be inline horizontal.
8. High pressure float and thermostatic traps shall be Spirax-Sarco Model FT450 (stainless steel models are FT16 and FT46)

D. Inverted Bucket Traps:

1. Inverted bucket traps for drips, tracers, or process service shall have internals made entirely of stainless steel with hardened heads and seats.
2. Bodies shall have horizontal inline connections and be made of cast iron for 250 PSIG or less, stainless steel for 250 to 650 PSIG.
3. Higher pressure units shall be made of either stainless or carbon steel.
4. Traps with pressures above 650 PSIG shall contain an integral check valve and their internals shall be renewable.
5. Inverted bucket traps shall be Spirax-Sarco Model B1H, SIB30, SIB45, UIB30, UIB45, 600/900 Series.

E. Thermodynamic Traps:

1. Thermodynamic traps for drips and tracer service to 600 PSIG shall have tight shut-off with no steam loss allowed either by bleed or “controlled leak” and shall operate with up to 80% back pressure.
2. Trap stations shall be protected with an integral or inlet strainer having a minimum free area of three times the pipe area. Both disc and seat shall be of hardened stainless steel with a Rockwell rating of at least 50.
3. When trap module replacement without disturbing the piping is required, two bolt universal connector traps shall be selected for pressures up to 450 PSIG inclusive.
4. Where specified, integral strainer blowdown valves shall be manufactured by the trap manufacturer.
5. Module gaskets shall be non-asbestos of flexitallic manufacture and bodies shall be made of 400 grade stainless steel.
6. Thermodynamic traps shall be Spirax-Sarco Model UTD-52, UTD-30 with blowdown, TD-52L, TD42.

2.3 STEAM TRAP ASSEMBLIES

A. Acceptable Manufacturers:

1. Spirax-Sarco (Basis of Design, Models as listed below)
2. Armstrong
3. Hoffman

4. Watson McDaniel
5. TLV

B. Steam trap assembly sizes shall be as noted on the plans.

C. Provide compact one piece pre-assembled station to include upstream and downstream isolation three piece ball valves, strainer with blowdown valve, check valve plus two-bolt repair for replacement steam traps.

D. Internal parts of ball valves, check valve, and strainer shall be maintainable.

E. The blowdown valve shall be wrench operated to keep operator clear of the blowdown stream.

F. Steam trap stations shall be compact type Spirax-Sarco Steam Trap Station Model STS17.2 or approved equal.

G. Station configurations shall include the following:

1. Trap of choice with universal swivel connector: Thermodynamic and Float and Thermostatic (specifications below)
2. 1/2”, 3/4” or 1” connections
3. NPT, ASME FLG, or SW end connections
4. Right hand and left hand configurations
5. Single upstream isolation
6. Factory Insulation jacket

H. Warranty protection: 10 year minimum warranty, covers trap station and connected steam trap.

I. Universal Steam Traps:

1. Float and Thermostatic Trap (LPS, MPS, or HPS):

a. Trap shall be attached to the station universal swivel connector by two bolts to enable simple and rapid installation and replacement.
b. The connector is designed to allow installation on pipe work that is vertical, horizontal, or any angle in between.
c. Operation shall be self-priming, with orifice size selected for the capacity required and system differential operating pressures up to 465 PSID.
d. The trap itself shall be Float and Thermostatic of stainless steel construction with body test plug.
e. Float and thermostatic traps shall be Spirax-Sarco Model UFT32 or approved equal.

2. Thermodynamic Trap (MPS & HPS Drip):

a. Trap shall be attached to the station universal swivel connector by two bolts to enable simple and rapid installation and replacement.
b. The connector is designed to allow installation on pipe-work that is vertical, horizontal, or any angle in between.
c. Operation shall be on/off discharge with tight shut off and no bleed or "controlled" leak, with back pressures up to 80% of inlet pressure and have an operating pressure up to 450 PSIG.
d. The trap itself shall be Thermo-Dynamic® disc type of stainless steel construction and integral seat design with hardened disc and seating surface.
e. Cap to have integral ceramic insulator with stainless steel cover.
f. Thermodynamic traps shall be Spirax-Sarco Model UTD52L or approved equal.

2.4 STEAM PRESSURE REDUCING STATION

A. Furnish and install a pressure reducing stations at the locations indicated on the drawings. The reducing stations shall be as follows:

1. Armstrong GP Series steam regulator with remote mount pilot or equivalent as manufactured by McDonnell and Miller, Spencer, or equal as approved by the professional.

a. Steam entering pressure, 75 PSIG; steam outlet pressure 40 PSIG. Stages and capacities shall be as indicated on the drawings.

2. The steam regulator shall have a ductile iron body with NPT connections. Noise level 84.5 dBa +/- 1% without the sound attenuating blanket.
3. A steam relief valve, 4" x 6" outlet x "M" orifice, set at 50 PSIG, Conbraco, Kunkle, Watts, or approved equivalent.
4. One (1) 6" drip pan elbow.
5. Provide a sound attenuating blanket for each pressure reducing valve.

2.5 FLASH TANK

A. Furnish and install a common high pressure return flash tank in the boiler room. The flash tank shall be designed to meet and/or exceed the ASME boiler and pressure vessel code. The entire pressure vessel is built in accordance with a complete ASME approved quality control system which is supervised by a third part authorized inspector. Vertical flash separator is to be built to ASME Code Section VIII, Division 1 of the boiler and pressure vessel code. Upon completion, the pressure vessel is hydrostatically tested, inspected, and stamped with registered national board number.

B. The flash tank shall be suitable for receiving, venting, sorting and discharging to the specified condensate surge tank the effluent discharged from steam traps on high and medium pressure steam systems. All material vessels shall have a centrifugally baffled blow-off inlet to allow for the flashing of steam.

C. The separator shall be constructed of a minimum of ⅜" thick ASTM A285 steel shell with a stainless steel striking plate.

D. The tank shall have the following minimum connections:

1. 4" high pressure return inlet.
2. 10" vent.
3. 8" drain.
4. Gauge glass with shutoff valves.
5. 1½" clean out connection and drain.

E. Equipment shall be installed in accord with the manufacturer's instructions and complete in all respects with accessories and auxiliary equipment and in accord with the requirements of the Pennsylvania Department of Labor and Industry.

F. Flash tank shall be manufactured by Burnham corporation, Bryan Steam Corporation or Fulton Boiler Works, or equal approved by the Professional.

2.6 BLOWDOWN SEPARATOR

A. Furnish and install a common blowdown separator for the boiler. The separator shall be designed to meet and/or exceed the A.S.M.E. boiler and pressure vessel code. The entire pressure vessel is built in accordance with a complete A.S.M.E. approved quality control system which is supervised

by a third part authorized inspector. Vertical blowdown separator is to be built to A.S.M.E. code section viii, division 1 of the boiler and pressure vessel code. Upon completion, the pressure vessel is hydrostatically tested, inspected, and stamped with registered national board number.

B. The separator shall be constructed of a minimum of ⅜" thick steel shell and ⅝" thick flat heads. All material vessels shall have a centrifugally baffled blow-off inlet to allow for the flashing of steam and include a 3 x 4 handhole for internal inspection of the pressure vessel.

C. The separator shall have the following minimum connections:

1. Cold water supply inlet.
2. 5" vent.
3. 5" drain.
4. Thermometer.
5. Temperature sensing well.
6. 1½" minimum blowdown inlet connection.

D. The separator shall be furnished with an after cooler system with ball valve, strainer, thermometer and self actuated valve for cold water supply.

E. Each self-actuated valve shall be a minimum of 1¼" and sized to allow a maximum of 135˚f discharge temperature. Valve shall be a pressure-balanced design, employing synthetic rubber sealing diaphragms correctly proportioned to the valve port area, balancing valve against both gradual and sudden water pressure changes and seal water away from range spring and guides and providing protection against high water surge pressures.

F. Equipment shall be installed in accord with the manufacturer's instructions and complete in all respects with accessories and auxiliary equipment and in accord with the requirements of the Pennsylvania department of labor and industry.

G. Separator shall be manufactured by Shippensburg Pump co Model BDS 450 (Basis of Design), Burnham Corporation, Bryan Steam Corporation or Fulton Boiler Works, or approved by the Professional.

2.8 STEAM SEPARATOR

A. Furnish and install a high pressure steam separator for each boiler located in the boiler room. The steam separator shall be designed to meet and/or exceed the ASME boiler and pressure vessel code. The entire pressure vessel shall be constructed in accordance with a complete ASME approved quality control system which is supervised by a third part authorized inspector. Steam separator is to be built to ASME Code Section VIII, Division 1 of the boiler and pressure vessel code with welders certified to ASME Section IX. Upon completion, the pressure vessel is hydrostatically tested, inspected, and stamped with registered national board number.

B. The steam separator shall be suitable for removing nearly all moisture and solids above 10 microns.

C. The separator shall be constructed of ASTM 106 Grade B steel shell with ASTM A105 steel baffles.

D. Steam separator shall have an internal baffle that does not exceed an equivalent length of pipe. The steam separator shall be installed in a horizontal pipe configuration with the drain directly below the line. The steam separator shall have a 1½" NPT bottom drain on which a mechanical constant flow steam trap shall be installed.

E. Equipment shall be installed in accord with the manufacturer's instructions and complete in all respects with accessories and auxiliary equipment and in accord with the requirements of the Pennsylvania Department of Labor and Industry.

F. Separator shall be furnished by the specified boiler vendor and shall be manufactured by Penn Separator Corp. Model ISH 4-10 for Boiler 6 and Model ISH 8-16 for Boilers 2 and 3 (Basis of Design). Burnham Corporation, Bryan Steam Corporation or Fulton Boiler Works, or approved equivalent.

PART 3 – EXECUTION

3.1 INSTALLATIONS

A. Install all equipment per manufacturer's recommendations and Best Industry Standards.

END OF SECTION 23 2223

SECTION 23 5100 – BREECHING AND STACKS – INSULATED

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provision of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SUMMARY

A. This Section includes the following:

1. Listed double-wall vents.

1.4 SUBMITTALS

A. Product Data for the following:

1. Boiler breeching.
2. F.G.R. (Flue Gas Regulation) duct.

B. Shop Drawings: Shop Drawings: For vents, breechings, chimneys and stacks. Include plans, elevations, sections, details and attachments to other work.

C. Welding certificates.

D. Warranties: Special warranties specified in this section.

1.5 QUALITY CONTROL

A. Source Limitations: Obtain listed system components through one (1) source from a single manufacturer.

B. Welding: Qualify processes and operators according to A.W.S. D1.1, “Structural Welding Code-Steel,” for hangers and supports and A.W.S. D9.1, “Sheet Metal Welding Code,” for shop and field welding of joints and seams in vents, breechings and stacks.

C. Codes and Standards:

1. N.F.P.A.: Comply with N.F.P.A. 211 “Standard for Chimney’s, Fireplaces, Vents and Solid Fuel Burning Appliances.”
2. U.L.: Comply with applicable portions of U.L. safety standards; provide products which have been U.L. listed and labeled.
3. S.M.A.C.N.A.: Comply with S.M.A.C.N.A. Low Pressure Duct Standards for fabricated breeching and smoke pipe.
4. A.S.H.R.A.E.: Comply with the A.S.H.R.A.E. Equipment Handbook, Chapter 27, for Chimney, Gas Vent, Fireplace Systems, and material requirements and design criteria.

D. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.6 WARRANTY

A. The flue systems shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of ten (10) years from date of delivery. For the warranty to be in effect the following two (2) actions must be performed by the contractor.

B. Drawings showing the actual layout and drawn to scale, shall be provided by the manufacturer. The system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's ten (10) year warranty and in conjunction with sound engineering practice.

C. The inner diameter for flue system shall be verified by the manufacturer's computations. The computation shall be technically sound, shall follow A.S.H.R.A.E. calculation methods and incorporate the specific flow characteristics of the inner pipe. The Client Agency shall furnish the exact appliance operating characteristics to the factory representative. Operating characteristics shall include flue gas flow rate, BTU input, outlet temperature, local altitude, stack layout and available external pressure at boiler outlet etc. necessary to determine system operation at maximum and minimum levels of burner turndown range.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

2.2 LISTED TYPE VENTS

A. Manufacturers:

1. Van Packer Co.
2. Ampco.
3. Security Chimneys International, division of Lennox.
4. Selkirk

B. Flues/breeching and F.G.R. duct shall be dual wall construction. Inner wall shall be 316 stainless steel and outer wall shall be aluminized steel. Inner wall shall have a 1" insulation space to outer wall. The 1" inner space shall be factory packed with ceramic wool insulation. The system shall be laboratory tested and listed by Underwriters' Laboratories for outer pipe surface temperature.

C. Outer jacket shall be aluminized steel. All sections exposed to the outdoors will have a 304 stainless steel jacket.

D. Thickness of outer casing 0.034" for 6" to 24" diameter, 0.048" for larger diameters. Thickness of inner liner shall be 0.035" for all diameters.

E. System must be capable of handling equipment which produces exhaust flue gas at a temperature not exceeding 1000˚F under continuous operation, and 1400˚F under intermittent operation conditions.

F. The flue system shall be designed and installed to be gas tight and thus prevent leakage of

combustion of products. The flue shall be listed under U.L. 103 for 60" w.c. pressure without the use of sealants on the outer jacket. The system design shall compensate for all flue gas induced thermal expansion.

G. The inner pipe joints shall be sealed by use of overlapping Type V bands with a premix 2000˚F sealant. The outer channel bands shall be sealed with a 600˚F sealant.

H. Sealing: R.T.V. high temperature silicone sealant for flue gas temperatures up to 600˚F. Sauereisen #33 ceramic joint cement or equivalent for flue gas temperatures over 600˚F.

I. When installed according to the manufacturer's installation instructions the flue and its supporting system shall resist side loads at least 1.5 times the weight per foot of the flue. Wall supports shall support 40' of vertical flue with a factor of safety of at least four (4). Plate supports shall support 200' of vertical flue in 6" through 20" I.D. sizes, 100' of vertical flue in 24" I.D. and larger sizes with a factor of at least four (4). The maximum distance between lateral supports for horizontal flue shall be 10' for 6" through 12" I.D. sizes and 15' for over 12" I.D.

J. Fabricate flues and breeching with fittings and accessories required.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

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

3.2 INSTALLATION

A. Furnish and install flue from the outlets of the gas appliance to the exit point.

B. Locate to comply with minimum clearances from combustibles and minimum termination heights according to produce listing or N.F.P.A. 211, N.F.P.A. 31, N.F.P.A. 54, whichever is most stringent.

C. Seal between sections of positive pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

D. Support flues at intervals recommended by manufacturer to support weight of sections and all accessories, without exceeding appliance leading.

E. Slope flues down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain. Provide trap in drain piping.

F. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish to A.S.T.M. C105.

G. Erect flues plumb to finished tolerance of no more than 1" out of plumb from top to bottom.

H. Install slip joints allowing removal of appliances without removal or dismantling of flue system.

I. Coordinate flashing and insulated thimble installation with roofing work.

J. Flue elbows shall be long radius type.

K. An insulating thimble shall be installed at the roof penetration with proper flashing and counter flashing installed to provide a leak proof installation.

L. All flues shall terminate a minimum of 3’ above the highest roof within a 10’ radius of the flue, or as required by State or Municipality Codes and by N.F.P.A. 211.

M. Coordinate interconnection to stack economizer. Refer to Specification Section 23 5150

3.3 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt and construction debris and repair damaged finishes.

B. Clean flues and combustion air piping internally, during and after installation, to remove dust and debris. Clean external surfaces.

C. Provide temporary closures at ends of flues and combustion air piping that are not completed or connected to equipment.

END OF SECTION 23 5100

SECTION 23 5224 – DUAL COMPARTMENT TRAY TYPE DEAERATOR

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 SECTION INCLUDES

A. Type of boiler feedwater equipment specified in this section includes one (1) boiler tray type dual compartment deaerator/surge with three (3) boiler feed water pumps and two (2) condensate transfer pumps.

B. Refer to other Division 23 sections for boilers, piping, specialties, concrete pads, etc., required for installation of boiler feedwater equipment.

C. Refer to Division 26 sections for field installed electrical wiring required for boiler feedwater equipment.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of boiler feedwater equipment, of type and capacity required, whose products have been in satisfactory use in similar service for not less than ten (10) years. The deaerator shall be from the same manufacturer, without exception.

B. Regulatory Requirements – U.L. and N.E.M.A. Compliance: Provide electric motors and products in which have been U.L. listed and labeled and comply with N.E.M.A. standards.

C. Completely prefabricate pipe, wire system, and undergo a functional factory test and inspection, prior to shipment. Client Agency and engineer shall be permitted to witness tests.

D. Design and Construction Standards: In addition to the minimum standards, the deaerator shall be designed, constructed and tested accordance with the Heat Exchange Institute (H.E.I.) Standards and Specifications for Deaerators, Fifth Edition, 1992.

E. A.S.M.E. Compliance: A.S.M.E. B31.1, “Power Piping.” Safety valves and pressure vessels shall bear the appropriate A.S.M.E. label.

F. Fabricate and label deaerator tanks according to A.S.M.E. Boiler and Pressure Vessel Code: Section VIII, “Pressure Vessels,” Division 1.

G. Factory install and test piping that connects pumps to tanks according to A.S.M.E. B31.1, “Power Piping.”

H. Factory test performance and certify test results on packaged deaerator units, according to A.S.M.E. P.T.C. 12.3, before shipping to project.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product, including rated capacities of selected modes clearly indicated, current accurate pump characteristics, performance curves with selection points clearly indicated, weights (shipping, installation and operating), furnished specialties and accessories and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly type shop drawings indicating dimensions, weight leadings, required clearances and methods of assembly of components.

C. Wiring Diagrams: Submit ladder type wiring diagrams for electrically operated boiler feedwater equipment. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.

D. Maintenance Data: Submit maintenance data and parts lists for each boiler feedwater equipment item, including "trouble-shooting" maintenance guide. Include this data and product data in maintenance manual in accord with provisions of Section 01 33 00.

1.6 WARRANTY

A. The receiver shall carry a 10 year warranty against corrosion failure provided they are used as specified and in compliance with the manufacturer’s instructions and the pumps and control panels will carry a two year warranty against failure except for the mechanical seal from date of shipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide dual compartment deaerator with carbon steel/stainless steel receivers of one (1) of the following:

1. Shipco ISTP-2C (basis of design).
2. Bryan Steam Corp.
3. Superior Boiler Works
4. Manufacturer approved by the Professional.

2.2 PACKAGED DEAERATOR SYSTEMS

A. The receiver shall be a single unit two compartment design of welded steel construction, elevated to meet the NPSH requirements of the boiler feed pumps (with 2 ft. of safety factor), horizontal with convex flanged and dished heads. The boiler feed section receiver shall be constructed of ASTM A285 Grade C steel, ASME Code Stamped for 50 PSIG with 1/16" corrosion allowance added, supported by steel tubing and have a capacity as shown on the drawings. The surge section receiver shall be constructed of 316L stainless steel. The boiler feed receiver shall be equipped with the following: (1) top and bottom shut-off water level gauge with automatic shut-off if glass is broken, (1) dial thermometer with separable well, (1) isolation valve between receiver and pump plus a valve in each bleed line installed for maintenance, (1) manhole for tank inspection, (1) stainless steel chemical feed quill, (1) sampling valve, (1) overflow drainer, (1) full size relief valve to relieve full capacity of the regulators, externally mounted high and low level alarm switches and low water cut-off switch. A suction isolation valve and an expansion coupling shall be installed in the suction piping between the receiver and the pump(s) to permit servicing the pump(s) without draining the receiver. The individual pump suction piping (manifolded suction

lines not acceptable) must be sized for a velocity of 2.9 ft./sec. or less and contain no suction strainers. A liquid filled discharge pressure gauge with snubbers shall be provided for each pump.

B. The boiler feed receivers shall be divided into two separate sections. The boiler feed or deaeration section and the accumulator or surge section shall be divided by a double inner head with the dead air space between the two inner heads to be packed with fiberglass insulation and have a breather and drain connection.

C. The surge or accumulator section shall be equipped with the following: (1) top and bottom shut-off water level gauge with automatic shut-off if glass is broken, (1) dial thermometer with separable well, (1) manhole, externally mounted high and low level alarm switches, low water cut-off switch. A suction isolation valve and an expansion coupling shall be installed in the suction piping between the receiver and the pump(s) to permit servicing the pump(s) without draining the receiver. The tank shall contain a vent and an overflow connection (contractor to field pipe overflow “P” trap. The individual pump suction piping (manifolded suction lines not acceptable) must be sized for a velocity of 5 ft./sec. or less and contain no suction strainers. A liquid filled discharge pressure gauge with snubbers shall be provided for each pump.

D. The tank portion of the unit shall be separable from the base skid to facilitate rigging/installation. The unit shall be shipped as a factory assemble unit. If required for installation, the contractor shall be responsible for the field separation and reassembly of the unit. The factory tank stand, piping and wiring shall have junction points to facilitate field separation/re-assembly. The custom tank OD shall be 60” and shell length 96” to facilitate the required maximum field dimensions.

E. A quick opening bypass shall be installed between the deaeration and accumulator compartments.

F. All controls switches and valves to have a NEMA 4 rating.

G. A 300 Series stainless steel deaeration spray box with integral cascade trays containing a spray manifold with stainless steel spray manifold and nozzles shall be flange mounted to the boiler feed receiver. A dial thermometer and a pressure gauge shall be an integral part of the manifold assembly.

H. Accessories:

1. Modulating valve with bypass for DA level control of pumped condensate from Surge Tank. A DP Transmitter shall be utilized for level control on the DA and Surge chambers.
2. An emergency modulating water make-up assembly shall be installed on the DA chamber. The assembly shall consist of a controller, transmitter and valve with a three-valve manual bypass and wye strainer. The capacity of the transfer valve shall be equal to 100% of the load with a 25 PSIG drop across the valve. Transfer assembly will also send 4-20mAmp signals remotely as needed as well as alarms.
3. Two direct injection steam heating assemblies must be installed in the DA receiver side. The deaeration assembly and the sustaining assembly shall consist of a double flange mounted stainless steel injection pipe, steam control valve, pressure regulator, wye strainer and (1) compound gauge for measuring vacuum or pressure gauge on unit. The two heating assemblies shall be sized for the emergency 100% make-up load capacities and locations as shown on the drawings to prevent wire draw.
4. A magnesium anode shall be mounted on the receiver to inhibit electrolytic corrosion and shall be mounted in 1¼” removable plug.
5. Conbraco 119MKC, 3” Inlet, 4” Oulet SRV set at 15 psig for DA chamber.

I. Boiler Feed Pumps (3):

1. The centrifugal boiler feed pumps shall be mounted on the receiver suction piping. The pumps shall be (Vertical) multi-stage, Goulds eSV series. The pump shall be flexible coupled permanently aligned with a C-face motor connected to the bearing housing which is C-face connected to the pump. Motors shall be rated for use with factory supplied VFD's. Motor bearings shall be extra heavy ball type with high temperature grease. The pump suction flange shall be an ASA design. The pump discharge shall be also be an ASA flange design. The Silicon Carbide/ Viton seal shall be rated for 250°F service. The entire pump shall be dynamically balanced to deliver its full rated capacity with no less than four (4) feet of NPSH. The pump shall have a NEMA standard shaft. The horsepower and electrical characteristics shall be as shown on the drawings. Each feed pump shall be capable to deliver 36 gpm at 358' TDH.
2. Each boiler feed pump will have a factory installed automatic flow control valve rated for 275 degrees minimum with a 8-128 spring range in the discharge of each feed water pump. The feedwater discharge piping on the feedwater pumps shall be ASME B31.1 power piping shall be schedule 80 with an Automatic flow control valve, non-slam spring loaded check valve and a gate valve which will be manifolded together to a common point.

J. Transfer Pumps (2):

1. The centrifugal transfer pumps, which must be cast, machined and assembled in the USA, must run continuously and shall be mounted on the receiver suction piping. The pumps shall be a single stage close- coupled design. The pump shall be a cast bronze impeller for long life and durability that is bronze fitted to the cast iron pump housing with a renewable bronze wearing ring. The mechanical seal shall be rated for 300°F service. The entire pump assembly shall be permanently aligned and dynamically balanced to deliver its full rated capacity. The motor shall have a NEMA standard shaft. The horsepower and electrical characteristics shall be as shown on the drawings. No bypass line is required or needed or will be used with these pumps. The transfer pump discharge shall be factory installed to include a Gate, non-slam spring loaded check valve and balancing valve on each pump to a manifold with factory piping them run to the modulating transfer valve assembly.
2. Each continuously running boiler feed and transfer pump will have a factory installed bypass line with a stainless steel orifice.
3. The manufacturer shall furnish a certified pump performance test for all pumps on unit. The pump manufacturer shall furnish complete elementary and connection wiring diagrams and installation and operation instructions.
4. The pump manufacture, panel manufacturer and the ASME code receiver manufacture shall be one in the same and shall hold the warranty on both items as well.
5. The Unit shall be Factory insulated with a steel jacket unpainted with 2" fiberglass insulation.
6. Do not paint Stainless steel, galvanized or aluminum surfaces.

K. Deaerator Control and Surge Tank Control Panels shall be by SCC. PLC based control system with 10" HMI. Controllers shall include Modbus communication for complete integration to Plant Master Control Panel & DDC/BAS SCADA system for remote monitoring & data acquisition. NO EXCEPTIONS. Refer to 23 5210.

1. Each Control component shall be provided by the unit manufacturer for operation as follows: the pumps shall run continuously based on the manual selection of pump.
2. Controls and pressure transmitter as required to automatically bring a stand-by boiler feed pump on line in the event of a drop in the boiler feed pump header pressure. This is controlled by the panel PLC.

    a. The unit manufacturer shall furnish, mount on the pump unit, and wire a NEMA 4 control cabinet with piano hinged door and seal-tite conduit. Panel shall include:

1) 10” HMI with PLC including four (4) analog inputs and four (4) RTD inputs. Configured for direct interface to Plant Master supplied by installing contractor. HMI shall display tank level, level alarms, pump status, pump alarms, tank pressure and tank temperature.
2) Three (3) “Continuous-Off-Standby” selector switches in panel for boiler feed pumps.
3) Three (3) Pump running pilot lights in each panel.
4) Control Circuit disconnect switch with cover interlock in panel.
5) Numbered terminal block in panel.
6) Fused control circuit transformer when the motor voltage exceeds 130 volts in panel.
7) Momentary contact “test” push buttons in panel.
8) Single point power connection in panel.
9) Elapsed run time meters graduated in hours in panel.
10) Electrical run cycle timer which will alternate the lead pump over to the lag pump based on a selected run time in panel.

b. Each Control cabinet shall contain U.L. listed or recognized components. Control cabinet shall be listed and labeled by Underwriter’s Laboratory.

3. The installing contractor, in addition to the pump control(s), shall provide and install all low water burner cut-off switches, all low water alarms, and all associated circuits in accordance with all local codes.
4. The unit shall be factory tested as a complete unit and a certified test report of pump characteristics produced, which shall be submitted prior to shipment. The unit manufacturer shall furnish complete elementary and connection wiring diagrams, piping diagrams, and installation and operation instructions.
5. The entire pump package will be U.L. labeled for insurance purposes and bear and UL stamping on the complete package.
6. Required interface relays and sensor to direct communicate with the specified Plant Master Control System via Modbus.

2.3 PERFORMANCE

A. Dual Compartment Tray Type Deaerator shall be rated as scheduled on the contract drawings. Any deficiencies in the dual compartment deaerator capacities and ratings will not be accepted.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine area and conditions under which boiler deaerator equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION – BOILER DEAERATOR EQUIPMENT

A. Comply with boiler deaerator equipment manufacturer’s instructions for installation, except as otherwise indicated.

B. Comply with installation requirements of local and state boiler codes, and applicable provisions of N.F.P.A. and A.S.M.E. Boiler Code Standards.

C. Install boiler deaerator equipment on 4” high concrete pad where indicated, maintain manufacturer’s recommended clearances around and over equipment.

D. Install feedwater and surge tank equipment accessories not installed at factory.

E. Connect as indicated, boiler feedwater piping, vents, drains, condensate piping and make-up water.

F. Furnish an electrical installer, manufacturer's wiring diagram, and electrical requirements for installation of field wiring required for boiler feedwater equipment.

G. Start-up deaerator/surge system equipment, in accord with manufacturer's start-up instructions and in presence of equipment manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

3.3 INSTALLATION – BOILER DEAERATOR EQUIPMENT

A. Provide service of manufacturer's technical representative to instruct Client Agency's personnel in operation and maintenance of boiler feedwater equipment.

B. Schedule training with Client Agency, provide at least seven (7) day notice to contractor and engineer of training date.

END OF SECTION 23 5224

SECTION 23 5239 – FIRETUBE BOILERS AND BOILER PLANT CONTROL SYSTEM

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions to the Construction Contract”, “Special Conditions", and “Division 01 — General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section

1.3 SECTION INCLUDES

A. High Pressure Firetube Boilers.

B. High Efficiency, Dual Fuel, Low NOx Burners.

C. Boiler Trim.

D. Fuel Burning System.

E. Boiler Cleaning.

F. Plant Master Control Panel.

G. Draft Control System.

H. Emergency Shutdown System.

I. Boiler Flow Meters.

J. BMS/CCS retrofit of existing burners

1.4 REFERENCES

A. A.G.A. – Director of Certified Appliances and Accessories.

B. A.N.S.I./A.G.A. Z21.13 – Gas Fired Low Pressure Steam and Hot Water Boilers.

C. A.N.S.I./A.G.A. Z223.1 – National Fuel Gas Code.

D. A.N.S.I./A.S.M.E. Section I – Boiler and Pressure Vessels Code – Rules for Construction of Power Boilers.

E. A.N.S.I./A.S.M.E. Section 8D – Boiler and Pressure Vessels Code – Rules for Construction of Pressure Vessels.

F. A.S.M.E. Compliance: A.S.M.E. B31.1, “Power Piping.” Safety valves and pressure vessels shall bear the appropriate A.S.M.E. label.

G. N.F.P.A. 70 – National Electrical Code.

H. NFPA 54 (AGA Z223.1): National Fuel Gas Code.

1.5 SUBMITTALS

A. Product Data: Submit data on general layout, dimensions, size, and location of connections, wiring diagram and piping detail.

B. Submit manufacturer's installation instructions.

C. Submit “Commonwealth of Pennsylvania Boiler Installation Report” to Division of Boilers, Bureau of Occupational and Industrial Safety, Department of Labor and Industry, Harrisburg, Pennsylvania 17120. Include copy in operation and maintenance data.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include manufacturer's descriptive literature; operating instructions, cleaning procedures, replacement parts list and maintenance and repair data.

1.7 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacturing of the types and sizes required, whose products have been satisfactorily serviced, in Pennsylvania, under similar conditions for no less than ten (10) years.

B. Manufacturer Qualifications: Firm whose boilers are listed by product name and manufacture in American Boiler Manufacturer’s Association and comply with requirements indicated. Firetube boiler must be manufactured in the United States and furnished with Pennsylvania ST Forms. Boilers in the specified size range must have been in production by the manufacturer for a minimum of ten (10) years.

C. Vendors: Boiler/burner unit shall be furnished as complete factory approved and integrated factory assembled unit. A single local factory trained organization shall assume full responsibility for the supervision of the installation and the start-up of this equipment.

D. Any and all equipment pertaining to this Specification Section and corresponding drawings must be listed by name of the manufacturer’s to be considered for approval by the Client Agency and his representatives. Equipment quoted by manufacturer’s not specifically listed in the Specifications and Drawings will be summarily rejected for use on this project.

1.8 REGULATORY REQUIREMENTS

A. Conform to applicable N.F.P.A. 70 code for internal wiring of factory wired equipment.

B. Conform to A.N.S.I./A.S.M.E. Section I, CSD-1, NFPA-85 and Section 8D and A.N.S.I./A.G.A. Z21.13, U.L. 726 for boiler construction. Provide boiler registered with National Board of Boilers and Pressure Vessel Inspectors and with the State of Pennsylvania.

C. Units: U.L. labeled.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect units before, during and after installation from damage to casing by leaving factory-shipping packaging in place until immediately prior to final acceptance.

B. Manufacturer’s local representative shall be on site during the boiler rigging and installation to ensure proper handling.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Provide Client Agency with manufacturer's warranty for the entire system, including hardware, software and components for a period of one (1) year from date of substantial completion and acceptance by Client Agency, in accord with conditions contract.

B. Warranty, by the Manufacturer, shall be for a period of 12 months after start-up date. Intended start-up date shall be no more than 180 days after delivery date. Warranty shall be for all parts and all labor to repair or replace parts.

C. Manufacturer shall further warrant for fifteen (15) years, parts and labor, non-prorated, the boiler's major pressure vessel components, including tubesheets, furnace and rear turnaround chamber.

D. Additionally, the manufacturer shall warrant for fifteen (15) years, parts and labor, non-prorated, the boiler's refractory in the front and rear firebox doors.

E. Boiler tubes shall carry a three (3) year warranty against tube leaks when the boiler is operated and maintained within the manufacturer's design parameters. In the event the manufacturer does not offer a three-year (3) tube leak warranty, the manufacturer shall provide a bond in the amount of 30% of the boiler sell price for labor and material to repair or replace any tube leaks for three years.

1.12 MAINTENANCE SERVICE

A. Furnish service and maintenance of boilers for one (1) year from date of substantial completion.

B. Provide emergency call back service at all hours for this maintenance period at no additional cost to the project.

C. Maintain locally, near place of the work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

D. Perform maintenance work using qualified personnel under supervision of boiler manufacturer's representative.

1.13 FACTORY TEST REPORT

A. Data on each fuel fired at minimum, 25%, 50%, 75% and 100% of rated capacity:

1. Fuel input or flow rate in BTU/hr and volumetric measurement corrected to STP.
2. Flue oxygen levels or percent excess air.
3. Flue carbon monoxide content expressed in PPMVD.
4. Flue NOx expressed in PPMVD corrected to 3% flue O2 content.
5. Boiler steam pressure.
6. Flue outlet gas temperature (stack).
7. Fuel supply pressure.
8. Fuel regulated pressure.
9. Fuel manifold or nozzle pressure.
10. Flame monitor signal strength on primary fuel(s).
11. Furnace pressure measured at the distal end of the furnace tube.
12. Combustion air static pressure profile.

13. Other data or information as applicable.
14. Name, signature and date of each tester certifying the accuracy of the re- sults. A copy of the combustion analyzer's current calibration certification shall be provided to the Client Agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Boiler Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Basis of Design: Superior Boiler Works, Inc.
2. Johnston Boiler Company
3. Burnham Commercial
4. Or as approved by the Professional.

B. Burner Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Basis of Design: Weishaupt Gas/#2 Oil ULN Burner
2. Oilon Gas/#2 Oil ULN Burner
3. Or as approved by the Professional.

C. The pressure vessel shall have a design pressure of 150 psig, and an operating pressure of 75 psig saturated steam in accordance with ASME Power Boiler Construction Code, Section 1, and the laws of the state of Pennsylvania including emergency shutoff buttons at each exit door. The boiler shall be registered with the National Board of Boilers and Pressure Vessel Inspectors, and with the state of Pennsylvania boiler inspection department.

2.2 BOILER TYPE

A. Provide two (2) 500HP, Scotch design, three pass wet-back firetube boilers arranged for automatic firing with natural gas per the contract drawing Schedule. Boiler shall be complete with natural gas ultra low NOx burner capable of utilizing no. 2 fuel oil for backup, controls, boiler trim, fittings and appurtenances necessary for connection and operation of a complete high pressure steam plant.

B. Provide one (1) 125HP steel, Scotch design, three pass wet-back firetube boilers arranged for automatic firing with natural gas per the contract drawing Schedule. Boiler shall be complete with natural gas low NOx burner capable of utilizing no. 2 fuel oil for backup, controls, boiler trim, fittings and appurtenances necessary for connection and operation of a complete high pressure steam plant.

C. Boilers shall be rated with certified test results to have a higher efficiency at low fire than high fire. The high fire efficiency shall be a minimum of 83.33% with natural gas.

D. The certified boiler radiant heat loss shall be less than 1/4% of the boiler nameplate rating.

2.3 PERFORMANCE

A. Boiler shall be rated as scheduled on the contract drawings. Any deficiencies in the boiler output will not be accepted.

B. Burner designs that utilize Flue Gas Recirculation (FGR) to achieve Ultra Low NOx performance as outlined above are not acceptable under this specification.

C. The two (2) EA 500 BHP Ultra Low NOx boilers must meet the following emission standards: NOx - 9 ppmdv NOx at 3% O2 whe firing natural gas; 90 ppmdv Nox at 3% O2 when firing No. 2 fuel oil; and 130 ppmdv CO at 3% O2 on either fuel. These non-exempt boilers must also pass the visible opacity standard of not exceeding a visible opacity reading of equal to, or greater than, 10% opacity for a period or periods aggregating more than three (3) minutes in any one hour or equal to or greater that 30% visible opacity at any time.

D. The 125 BHP boiler must meet the following emissions standards: 30 ppmdv NOx at 3% O2 whe firing natural gas; 90 ppmdv NOx at 3% O2 when firing No. 2 fuel oil and 300 ppmdv CO at 3% O2.

2.4 BOILER DESCRIPTION

A. Constructed and tested for 150 psi steam design pressure. Operating pressure shall be 75 psig steam.

B. The boiler construction shall be of the three pass, full wetback design, to provide the best ratio of radiant heating surface to convection heating surface, for maximum heat transfer. All 2nd pass tubes shall be factory seal welded to ensure extended life and leak proof operation. The manufacturer shall warrant the boiler against tube leaks for 3 years from date of factory startup.

C. The tubes shall be X-ID type, 12 gauge construction, minimum 0.105” wall thickness.

D. The large diameter corrugated furnace shall be located in the bottom third of the boiler which shall provide for maximum heat transfer while being in contact with the coolest boiler water.

E. The rear turnaround area shall be submerged within the boiler water. Refractory baffling between gas passes will not be permitted.

F. The boiler front shall consist of two separate davited doors to allow fireside access to the front tubesheet without removal of the door plates, baffles, or the disconnecting of any fuel lines, linkage, or electrical connections.

G. The boiler shall have two davited rear doors to allow full access to the rear tubesheet.

H. The boiler shall be equipped with a minimum 18” diameter inspection opening to allow fireside inspection. Observation ports shall be provided for flame inspection at both the front and rear of the boiler. All doors shall be sealed gas tight with a ceramic fiber gasket, utilizing studs with lugs and replaceable nuts for ease of opening and closing.

I. All necessary handholes and manholes shall be provided in accordance with ASME Code. In addition, two handholes shall be located in the front tubesheet near the bottom of the boiler on either side of the furnace. An additional handhole shall be located at the rear doors to allow full access to the rear tubesheet.

J. The boiler shall be equipped with two lifting eyes.

K. The entire boiler shell shall be insulated with a minimum of two inch, eight pound density mineral fiber insulation, covered with a 22 gauge phosphate coated steel jacket. All openings in the jacket shall be fitted with cover rings. The steel jacket shall include a reinforced walkway along the boiler top center line.

L. The entire unit shall be factory painted with hard finish, heat resistant paint.

M. The boiler shall be mounted on a heavy structural steel base with runners extending beyond the burner to provide burner support and protection.

N. Platform Tabs shall be welded to vessel to facilitate field installation of ladder and platform assembly.

O. Flue Connection: Flange connection located at the rear of the boiler on the top centerline. The flue gas connection must be designed to support a minimum of 2,000 lbs of dead weight and have a ½" connection for a stack thermometer.

P. Stack Damper: integral damper with locking quad, modulation controlled by burner touchscreen to automatically maintain preset draft pressure within ±0.05 tolerance, factory installed and tested.

Q. Boilers shall be furnished with an industrial type UL listed forced draft flame retention gas burner as hereinafter detailed. Burner shall be complete with integral motor and blower for supplying sufficient combustion air with normal vent conditions. Refer to paragraph 2.6 – Fuel Burner System.

R. This Contractor shall extend gas vent line from the UL/FM/A.S.M.E. CSD-1 gas train of the boiler. Vent piping from gas train shall be extended to the exterior of the building in accordance with AGA and Gas Company requirements by this Contractor.

S. The boiler manufacturer shall furnish an agent or engineer to provide complete and detailed instructions for the operating personnel in the proper operation, care and maintenance of all equipment. All required service and maintenance for the first complete heating season shall be provided by the Installation Contractor. The boiler manufacturer's representative shall also provide all necessary supervision to the Installation Contractor, for the installation and operation of the boilers. Burners shall be placed in operation and adjusted for maximum burning efficiency by this boiler representative. In the process of effecting these adjustments, a combustion efficiency test shall be conducted with the use of combustion analyzer. This test shall be constructed under full load conditions and shall extend over a period of not less than one hour. Stack temperature, draft and carbon dioxide shall be recorded at intervals. A written report of the combustion test shall be rendered in duplicate to the Facility Maintenance Manager. Three (3) sets of operating and maintenance manuals shall be delivered to the Client Agency.

T. The boiler manufacturer shall be capable of providing factory service in the immediate vicinity and within a reasonable amount of time on a 24 hour a day emergency basis.

U. All power wiring to the boilers will be furnished and installed by this Contractor. All control wiring, including wiring from the separate-mounted low water cutoff switch, high limit switch and all associated safeties shall be furnished and installed under this Contract.

V. Gas piping will be extended to the boilers from the existing natural gas line by this Contractor.

2.5 STEAM TRIM

A. Water column type primary low water cutout and alarm. Differential pressure transmitter and feedwater controller. Controller shall be complete with reflex gauge glass, quick closing gauge cocks, tri-cocks and shunt trip pushbutton. All cocks shall have necessary chains and handles for operating from boiler room floor. DP transmitter shall be furnished with 3-valve manifold.

B. Electric feedwater valve with actuator. Factory installation shall include 3-valve manual bypass piping and diffuser. Valve body shall be sized to pass 200% of maximum boiler evaporation capacity. Valve shall include stem position indicator, ductile iron or bronze body, stainless steel seats and ductile iron strainer. Specified feed pump system will have full size bypass mode for no-flow conditions at this feedwater valve.

C. Auxiliary low water cutout. Control unit shall have manual reset feature, shunt trip pushbutton and be factory mounted in vicinity of blowdown valves.

D. High water cutout and alarm. Control unit shall be factory mounted at the boiler.

E. 6” dial steam pressure gauge.

F. Side outlet safety valves constructed and sized in accordance with A.S.M.E. and State of Pennsylvania requirements. Safety valves should be set at 85 psig. Field installation shall include drip pan elbows, vent pipe to outdoors, condensate piping to floor drain and test chains over pulleys to a point 5’ above boiler room floor.

G. Low limit pressuretrol. High limit pressuretrol with manual reset. Modulating controller shall be by burner internal lead controller.

H. 5” flue gas thermometer mounted at rear flue outlet.

I. Surface blowoff package including automatic blowdown system, sample cooler and test port and by-pass assembly. System shall be factory installed and wired. A full length skimmer tube shall be factory installed at the normal water level line.

J. The bottom blowdown package shall include (1) quick opening sliding gate type valves at each blowdown connection and (1) common slow opening valve. Blowdown valves shall be 2” and rated for 490 psig.

K. 2” Feedwater Gate & Check Valves, steel, 480 psig, factory piped.

L. One (1) 6” cast steel steam stop check non-return valves, angle pattern, 250# flanged.

M. One (1) 8” 300# flanged steel steam gate valves.

N. One (1) 8” x 6” x xx”L ASME Spool Pieces.

O. One (1) 6” x 8” x xx”L ASME Spool Pieces with ¾” tap and free blow valve.

P. The boiler manufacturer shall include all steam gate and stop check valves, steam spool pieces with drain fitting, A.S.M.E. code piping, feedwater valves, check valves, blowdown valves and pipe and fittings for the various steam trim items.

Q. All external boiler piping shall conform to the A.S.M.E. code, shall bear the PP stamp and shall be hydrostatically tested at the factory. This pertains to the water feed; blowoff and steam trim piping through the required valves.

R. Sequence Draft Controls System, with electronic controller, sensor, integral stack damper and damper actuator, factory installed and wired.

S. Boiler-Mounted Junction Box, NEMA 4, with seal-tite wiring.

T. Provide OSHA compliant ladder, platform and handrails, carbon steel construction, and painted safety yellow. Anchor ladder at top and bottom. Platform will provide access to all valves and devices on top of boiler. Ladder and platform shall comply with PA labor and Industry Boiler Division regulations.

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2.6 FUEL BURNING SYSTEM

A. Basic Burner System:

1. Burner control system and fuel system shall conform to applicable codes and with requirements of “U.L.”, A.S.M.E. CSD-1 Factory Mutual Insurance and NFPA-85. Formal

Factory Mutual Insurance approval is not required.

2. Burner shall be listed by Underwriters Laboratories Incorporated and shall bear the appropriate U.L. Label. Each burner shall be designed and constructed as an integrated combustion system package and shall be factory fire tested.
3. Burner shall have a cast aluminum burner housing and be capable of hinging open to the left or the right, and incorporating a self-checking differential combustion air pressure switch and burner flange safety interlock switch. The housing shall incorporate a large sight glass for flame viewing and a removable cover to allow free access to all serviceable components.
4. Burner air intake shall consist of multiple aluminum air intake vanes on the suction side for combustion air regulation. The combustion air fan shall be statically and dynamically balanced. Air louvers shall be controlled by a dedicated servo drive repeatable to 0.2 of an angular degree. Air intake shall include sound attenuating material.
5. Burner shall incorporate a stainless steel alloy flame tube. The burner diffuser, ignition electrodes, mixing assembly, and all serviceable components shall be accessible without need for burner removal.
6. Burner gas butterfly valve shall be integral to the burner allowing the gas train to be connected to the left or the right of the burner and be controlled by a dedicated servo drive repeatable to 0.2 of an angular degree.
7. In addition to the suction side air regulation, the combustion air shall be adjustable to suit the firing rate for the application. This shall be by means of an adjustable flame tube to diffuser position, and will change the pressure drop across the diffuser to provide optimal mixing pressure in accordance with the required maximum firing rate.
8. The entire fuel air ratio control system shall be free of linkages with each control component being individually controlled by dedicated servo drives programmable via the flame safeguard keypad.
9. The burner shall incorporate an internal shut off devise to prevent oil drip and seal the nozzle assembly to prevent evaporation and carbonization of the nozzle internals or nozzle tip when operating on gas.
10. Oil atomization shall be by mechanical means. The mixing case assembly shall incorporate flexible stainless braided oil hoses to allow removal of the entire mixing case for service.
11. All functions including burner history, commissioned values, operating parameters and pressure temperature settings shall be accessible/adjustable without the need for laptop computer or other special tools.
12. There shall be four levels of password protection and both the flame safeguard programming pad and the main module shall hold the programmed data with capability of uploading/downloading from one to the other should either module be damaged.
13. Burner fuel air ratio shall be controlled by individual servomotors controlling suction side air, pressure side air and gas flow control valve. A common mod motor and linkages for the combustion air and gas valve will not be accepted.
14. Burner fuel air ratio shall be infinitely adjustable throughout the entire firing range with separate and independent programmable curves for each fuel via the flame safeguard programming pad.
15. The burner oil pump shall be engaged/disengaged automatically when fuels are changed via an electromagnetic clutch assembly to eliminate pump wear when firing gas.
16. Automatic ignition of the main fuel (natural gas or #2 fuel oil) shall be from a natural gas or emergency propane pilot which will cut off after main flame has been established. Pilot gas train shall include shutoff cock, pilot pressure regulator and dual pilot solenoid valves.
17. Gas firing accessories.

    a. Main gas shutoff valve with pilot line connection.
    b. Main gas pressure regulator with vent to outside atmosphere.
    c. Dual high gas pressure switches with vents piped to outdoors.
    d. Low gas pressure switches with vents piped to outdoors.
    e. Dual main gas shutoff valve with integral pressure regulator and automatic valve proving control.
    f. Leakage test cock.
    g. Factory mounted metering gas flow control valve.

h. Pressure gauge with gauge cock for burner manifold pressure.
i. Gas train components sized for a supply pressure of 2 to 5 psi.
j. Vents from the main pilot gas pressure regulators, and the high and low gas pressure switches shall be connected into vent lines as shown on the drawings and piped outdoors terminating with insect cap in an area where vented gas cannot be drawn into the building.
k. Where the specifications exceed the requirements of the code and insurance requirements, the specifications shall be followed without exception.
l. Natural gas valve train shall be manufactured by Siemens Combustion Controls or equal as approved by the professional and supplied by the burner manufacturer.
m. Gas train components shall be factory assembled and tested by the manufacturer.

18. Fuel oil firing accessories shall include the following:

a. Integral fuel oil pump with magnetic clutch assembly.
b. Dual fuel oil supply valves.
c. Fuel oil regulator.
d. Fuel oil nozzle assembly with regulating nozzle.
e. Low fuel oil pressure switch.
f. Fusible link oil valve.
g. Fuel oil filter with spare fabric cartridge.
h. Fuel oil vacuum gauge with gauge cock.
i. Fuel oil nozzle pressure gauge with gauge cock.
j. Fuel oil supply pressure gauge with gauge cock.
k. Air/gas separator

19. Burner blower motor for 500HP boiler shall be 26.7 H.P. Consult schedule for required voltage.
20. Burner blower motor for 125HP boiler shall be 5.0 H.P. Consult schedule for required voltage.
21. Variable speed modulating burners shall be arranged for 10:1 turndown when firing natural gas. The Oxygen (O2) level for shall be a maximum of 3% at high fire and 4.5% at low fire, before the introduction of O2 trim controls.
22. Burner control system shall provide solid-state flame safeguard protection, pre and post purge, low fire start and modulated firing rate, 2 to 4 second shutdown on flame failure, and 10 second safety lockout. The air inlet damper shall close after each firing cycle to minimize standby loss during the "OFF" periods. All controls shall be wired for 120 volt operation. The flame safeguard system shall be as manufactured by Siemens Inc. (W-FM200/LMV-52) or equal as approved by the professional using a programming solid state control with keyboard display module and ultra-violet flame detector together with the appropriate auxiliary equipment. The burner control shall be capable of communication with the building automation system via BACnet IP.
23. The burner controls shall include flame safeguard control, 10” HMI, control transformer, signal lights, manual firing rate control, and flame failure alarm circuit. Burner motor, burner motor starter, interlocks, ignition equipment, and flame detector shall be factory wired to the control cabinet terminal strip.
24. Per A.S.M.E. CSD-1 Code, the burner control panel shall include a lockable disconnect switch and 3-phase fusing for the burner blower motor.
25. The boiler/burner controls shall be interlocked with the combustion air system.
26. All required interlocks and communication with the hereinafter specified Boiler Plant Master Control Panel shall be provided.
27. Burner manufacturer basis of design is Weishaupt. Burner manufacturer must be approved by the boiler manufacturer for use in the pressure vessel. A letter from an authorized officer of the boiler and burner manufacturer will be required for verification of same.
28. Sequencing draft controls shall be controlled by the burner HMI, modulating the stack damper to maintain preset draft conditions at all firing rates and temperatures.

2.7 BOILER CLEANING

A. Contractor shall do a boil-out of the new boilers using any commercially available product for this purpose. The boil-out shall include “OVER-THE-TOP” wasting of water. A temporary 2” pipe shall be run from the relief valve tapping to a floor drain to assure that grease and oils are floated to the top and out of the unit. Minimum time for the procedure shall be four (4) hours of constant water discharge alternating between bottom and top blowdown. At least two (2) complete bottom blowdown and complete refills shall be done. In the event multiple boiler boilouts are required, the Contractor shall be responsible for same. Consult with the project Water Treatment contractor for final procedure.

2.8 BOILER PLANT FLOW METERS (STEAM, NATURAL GAS, OIL, FEEDWATER)

A. Provide an ONICON Model F-5100 Insertion Thermal Mass Flow Meter as basis of design for natural gas flow or equivalent as approved by the professional, complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand-insertable up to 250 psi. Materials of construction for wetted metal components shall be 316 SS. The flow meter shall provide SFPM flow readings from a pair of encapsulated platinum sensors and shall not require additional temperature or pressure compensation. In addition, the meter shall continuously display information that can be used to validate the calibration of the meter. Each flow meter shall be individually wet-calibrated against a standard that is directly traceable to NIST*. A certificate of calibration shall be provided with each flow meter.

B. Provide Onicon Series 3000 Inline Electromagnetic Flow meter for Feedwater and Series 2000 Inline Vortex Flow meter, as basis of design, for boiler steam flow, or equivalent as approved by the professional.

C. Provide a Dwyer positive displacement fuel oil meter for boiler fuel oil flow.

D. Accuracy shall be within ± 1% of rate from 500-7000 SFPM and ± 2% of rate from 100-500 SFPM. Overall turndown shall exceed 1000:1. Output signals shall consist of the following: (1) analog 4-20mA output and (1) scalable pulse output for totalization. The meter shall be equipped with an integrally mounted graphical display that may be optionally remote mounted up to 1000 ft from the sensor. Each flow meter shall be covered by the manufacturer’s one-year warranty.

E. Provide a D-100 Series Display Module for local or remote indication of flow rate and total. Output signals shall be either serial network (protocol conforming to BACnet® MS/TP, BACnet/IP, LONWORKS®, MODBUS RTU RS485, MODBUS RTU TCP, JCI-N2, or Siemens-P1) or via individual analog and pulse outputs.

2.9 CONTROLS (NEW BOILERS)

A. Boiler Operating Controls:

1. Siemens LMV-52 (Basis of Design)
2. HAWK 4000
3. Honeywell HC900 Hybrid
4. Fireye Nexus 6100
5. Or equal as approved by the Professional

B. 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.

C. 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.

D. 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. The 0.2 Contractor shall turnover to the 0.4 Contractor the emergency shutdown stations for installation by the 0.4 Contractor. The 0.2 Contractor shall coordinate with the 0.4 Contractor the number and location of the stations.

E. Burner Flame Safeguard Controls:

1. Factory equipped with flame safeguard control and infrared flame scanner.
2. Parallel positioning actuators: Modbus servomotors with quick disconnect.

    a. Primary fuel, secondary fuel, air, flue gas recirculation (FGR)

3. Microprocessor-based, solid-state control having sequence and flame-on visual indication and fault code indications of flame safeguard trip functions.
4. Control shall include dynamic self-check logic.
5. Control shall have a fixed operating sequence incapable of being manually altered that includes start, pre-purge, pilot and main fuel ignition run, and post-purge cycles.
6. Control shall be non-recycle 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.

7. Control shall include a run/test switch to allow interruptions to sequence just after pre- purge and during pilot ignition trial, and run cycles for adjustments to firing rate motor, damper linkages, and pilot flame for minimum turndown tests.

F. Combustion-Air Controls: Factory equipped with motor-operated combustion-air damper and blower control to regulate burner fire according to load demand.

G. 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 shaft compensate for changes in ambient temperature, barometric pressure, humidity, and variations in fuel characteristics.

H. Boiler Management System (BMS) Interface: Factory install hardware to enable system to monitor, control,and display boiler status and alarms.

1. Communication Interface: ASHRAE 135 (BACnet IP) communication interface shall enable control system operator to remotely control on/off and capacity of boiler and monitor the boiler operation from an operator workstation. Control features are available, and monitoring points are displayed locally at boiler-control panel through the interface.

I. 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, pre-purge, pilot flame establishing period, main flame establishing period, run, flame proving and lockout, and post-purge.
    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.
    m. Monitor and display economizer temperature transmitters.

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.

J. 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.

K. 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.

L. 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 conduit. Use flexible conduit to make final terminations. Provide watertight installation for applications exposed to moisture.

2.10 PLANT MASTER CONTROLLER

A. Furnish and install a boiler room Boiler Control Panel to control all functions of the steam boiler plant. The new boilers shall be factory furnished to accept all inputs and provide all applicable monitoring points as required. The Boiler Control Panel shall interface to the BAS SCADA System via BACnet MS/TP, BACnet IP, Modbus (coordinate with BAS).

B. The Master Panel interface shall be capable of controlling up to eight (8) boilers, while operating LMV and/or RWF controls, with the following functionality:

1. Lead/lag operation with automatic boiler rotation, based on number of hours run or individual boiler startups.
2. Parallel or sequential modulation of burner/boiler firing rate.
3. Remote enable and setpoint adjustment via BMS.
4. Time or temperature based hot standby capability.
5. Low temperature/low fire hold capability.
6. System steam flow totalization based upon firing rate.
7. The Master Panel shall communicate with a local TS series touch screen/LMV CCS at each new boiler and all remaining existing boilers (retrofitted with SCC controls).
8. Forced lead boiler selection, which shall stop automatic boiler rotation.
9. Hand-Off-Auto selection.
10. Available override setpoint mode via a digital input.
11. Selectable boiler setpoint, based on a predetermined daily schedule.
12. Monitoring of individual boiler status and alarms.
13. Automatic configuration of local boiler touch screen graphics based on Master Panel selections.
14. Monitored analog inputs and outputs shall be configured based on manual input values.
15. Monitored digital outputs shall be configured based on the value in any of the Modbus registers and associated setpoints.
16. Standard or Metric unit display.
17. Twelve (12) selectable data logging variables, stored in CSV format on a USB drive.
18. Real time trending and data logging to a USB drive.
19. Six (6) selectable variables for trending up to seven (7) days.
20. Alarm history shall be stored for the most recent 250 alarms.
21. Screen saver with process variable, setpoint, and demand.
22. Ethernet and serial communications to local boilers, utilizing TS series touch screens or communication kits.

23. BAS communication shall include BACnet MS/TP; via an external protocol translator.
24. Email and text messaging of alarms and screen shots for up to six (6) recipients.
25. Screen shot capture via USB.
26. Remote monitoring capability via smart phone, tablet, and other mobile devices.
27. Short cut navigation from the overview screen on the HMI.
28. Multi-level, password protected screens.
29. Four (4) analog inputs with field configurable label, span, and type; 0-10V, 2-10V, 0-20mA, or 4-20mA.

    a. Each input shall be configured for low and high alarm setpoints, with auto or manual reset
    b. Totalization is available per minute or per hour

30. Two (2) analog outputs with field configurable span and type; 0-10V, 2-10V, 0-20mA, or 4-20mA

    a. Each output shall be configured for low and high alarm setpoints, with auto or manual reset
    b. Optional with the analog input module selection for hot water boilers

31. Four (4) Pt100 or Pt1000 RTD temperature inputs with field configurable label, optional for steam boilers

    a. Each input shall be configured for low and high alarm setpoints, with auto or manual reset

32. Four (4) digital outputs with field configurable logic, including ON and OFF delays

    a. Manual or automatic reset

C. The Plant Master Control system shall be by SCC Inc as basis of design or equivalent as approved by the professional. The controls will monitor boiler room operation (new boilers, existing boilers and new DA/Surge), control key equipment, communicate with the BAS SCADA system for monitoring, data acquisition and reduce operating cost and extend equipment life.

D. The Master Panel shall have the following operation:

1. Operation of the Master Panel boiler lead/lag system shall be selectable for sequential or unison modulation.
2. Individual boiler firing rates, pressure, and temperature shall be monitored.
3. Based upon the lead boiler firing rate, the first lag boiler shall be placed online.

    a. Additional lag sequenced boilers shall be placed online based upon total output from all operating boilers.

4. As total boiler output drops to a pre-determined setpoint, lag boilers will be taken offline and placed in standby, based upon programmed lag boiler sequencing.
5. Sequence of boiler operation shall be selectable via the Master Panel HMI touch screen.
6. Configurable boiler rotation shall be based on up to 999 hours.
7. A centralized display of LMV parameters and RWF parameters of every boiler shall be available via the Master Panel HMI touch screen.
8. Centralized alarm status for all boilers shall be available via the Master Panel HMI touch screen.
9. The Master Panel lead/lag system shall apply to the steam boilers and DA/Surge.
10. A remote monitoring application shall be utilized to view the Master Panel screen shots via a local CAT5 connection to the internet or intranet.

11. The Master Panel lead/lag system shall be capable of navigating through the local boiler touch screens to view and monitor all aspects of boiler operation, such as flame signal, system status, and parallel positioning information, as well as all temperature and pressure parameters.
12. The Master Panel lead/lag system shall provide centralized totalization for all boiler flow meters when optional expanded I/O is utilized.
13. If additional boilers are installed, the Master Panel lead/lag system shall not require any additional modules to be added in the field.
14. The Master Panel lead/lag system shall operate with any combination of boilers utilizing LMV linkageless controls systems, without utilizing a touch screen on each boiler.
15. If the optional temperature sensor is installed on steam boilers, the Master Panel lead/lag system shall perform a low fire hold based upon temperature.
16. If a temperature sensor is installed on steam boilers, the Master Panel lead/lag system shall modulate to maintain a preset adjustable pressure or temperature setpoint.
17. The Master Panel lead/lag system shall be capable of performing a hot standby routine to cycle connected boilers ON and OFF.

E. The Master Panel lead/lag HMI touch screen shall be 12 inches. The HMI shall provide the following operator interface information and selections:

1. Monitoring of all LMV5 system parameters at each boiler shall include, but not be limited to:

a. Boiler related alarm messaging and logging in plain text English
b. Steam or temperature actual value
c. Steam or temperature setpoint
d. Flame signal strength
e. Firing rate
f. Actuator position
g. Burner status and alarm status
h. Steam and gas flows.

2. Adjustment of operation and burner/boiler parameters shall include:

a. Boiler pressure/temperature setpoint
b. Master Panel pressure/temperature setpoint
c. Boiler automatic/manual operation, set firing rate in manual
d. Sequence of rotation in multi-boiler lead/lag configuration
e. Timing of lead boiler rotation

F. Failure of any component within the Master Panel will not result in a loss of boiler operation. Operation will revert to local PID control, located in the LMV5, utilizing a pre-programmed local setpoint.

2.11 BMS/CCS RETROFIT OF EXISTING BOILERS/BURNERS

A. The remaining existing boiler/burners shall have the Boiler Management System (BMS) and Combustion Controls System (CCS) removed and upgraded to Siemens Combustion Controls LMV52 with TS-Kits and expanded AI for plant monitoring as basis of design or equivalent as approved by the professional.

B. BMS/CCS shall be SCC LMV52 with TS Kits as basis of design, or equvalent as approved by the professional, and 10” HMI w/PLC to interface to the Plant Master Control Panel and SCADA on a seamless integration bus.

C. BMS/CCS upgrade shall include a complete, new panel in a NEMA 4X enclosure with cooling fan at each burner.

D. Servo motors for gas, fuel and air shall be replaced. Include necessary bracketing, adaptors and couplings.

E. Panel shall have the capability to provide drum level and/or draft control if specified for the existing boilers.

F. Existing burner controls retrofit work scope must be completed by boiler vendor for new boilers/ SCC, as basis of deign or equivalent as approved by the professional, authorized service representative for project continuity.

G. All electrical work must be in accordance with the Electrical specifications of this project.

H. Boiler Management System

1. The Boiler Management System (BMS) shaft provide a complete boiler room control solution, to include a master controller for boiler operations, individual boiler controls, feedwater pump controls, and the make-up air unit.
2. Manufacturers:
    a. Conexus
    b. Tridium Niagara 4 Supervisor
    c. Johnson Controls
    d. Rockwell Automation
    e. Or equal as approved by the Professional
3. Communications among the controls shall be via a stand-alone boiler plant BACnet IP ethernet network.
4. The system shall provide for local automatic boiler operations should the network fail.
5. The master screen located in the Control Room shall be able to show screens from any of the other connected panels.
6. The system shall see and acknowledge individual unit alarms both at the local control panel and the master panel.
7. The system shall have the ability to make callouts and sound alarms even in the event of a power failure.
8. All electronics shall be powered through individual panel uninterruptible power supplies (UPS).
9. The UPS's shall be sized to provide approximately 20 minutes of runtime for connected loads. The UPS's shall provide protection to electronic components during electrical transients.
10. Refer to Section 230900 Instrumentation and Control for HVAC for additional information.

2.12 DATA ACQUISITION SYSTEM (DAQ)

A. Separate system (if required) with its own UPS. DAQ shall have the ability to communicate solely with the Plant Master controller as well as to be able to tie to the network and communicate with all control panels to obtain the required data.

B. A PC running data acquisition software, Microsoft Office Professional, and the most up to date Windows operating system.

C. The PC shall have two solid state drives (primary and a backup) of at least 2 TB each.

D. Enhanced keyboard, optical mouse, and speakers.

E. Provide a minimum of two levels of security with password protected access.

F. The DAQ software shall have the following features and capabilities:

1. User friendly to access data, set up storage configuration, generate graphics, and configure reports.
2. Store data points at differing frequencies.

3. Export selected data to a spreadsheet (Excel) for analysis.
4. User friendly graphics to build display screens and populate data points.
5. Generate and display trend graphs.
6. Configuration and printing of various reports.
7. Points shall be trended per the requirements stated in Specification 230993 Sequence of Operation.
8. Monitoring and alarms to Facility Managers at their residence through an existing VPN network.

G. Provide report printer (all in one print/copy/scan/fax machine capable of producing 35 pages per minute double sided on 8-1/2"x11" and 11"x17") for printing data reports, trend screens, and screen captures. Machine shall be wireless capable and network capable and print/copy/scan/fax both in color and black and white.

H. Provide alarm printer, Dot matrix, for printing alarm events line by line.

I. System shall be configured and tested by factory trained and authorized personnel.

J. Provide a minimum of 1 day (8 hours) of on-site training for personnel.

K. Yearly updates shall be included for a period of five (5) years.

L. Refer to Section 230900 Instrumentation and Control for HVAC for additional information.

PART 3 - EXECUTION

3.1 BOILER INSTALLATION

A. Install boilers per manufacturer's recommendations and in accordance with all applicable codes.

B. Coordinate size and location of bases. Concrete, reinforcement, and formwork requirements shall be provided by the 0.1 Contactor. The 0.2 Contractor shall coordinate the location and size of the housekeeping pads maintain required PA Labor & Industry code clearances.

3.2 INSTRUCTION AND SERVICE

A. The boiler vendor, through the Contractor, shall furnish a start-up engineer to provide 16 hours of complete and detailed instruction for the operating personnel in the proper operation, care, and maintenance of all equipment. All required free service and maintenance of the first complete heating season shall be provided by this Contractor.

B. After each burner and combustion control system has been placed in operation, all equipment shall be adjusted for maximum combustion efficiency. In the process of effecting these adjustments, a combustion efficiency test shall be conducted with the use of an absorption type analyzer capable of measuring carbon dioxide, oxygen, and carbon monoxide. This test shall continue for the length of time necessary to adjust the burner for maximum efficiency at 100, 75, 50 and 25 percent of rating. Stack temperature, overfire draft, carbon dioxide, and oxygen shall be recorded. A written report of the combustion test shall be rendered, in duplicate, to the Facility Maintenance Manager.

C. If requested, the boiler vendor shall provide proof of his ability to render competent service for the maintenance and repair of all equipment on a 24-hour basis. He shall further attest that a complete inventory of parts, controls, etc. is maintained locally and that an effective service organization with these qualifications has been maintained locally for five (5) years or more and presently maintains a staff of at least five (5) factory trained service technicians.

D. The boiler supplier shall be responsible for supplying to the HVAC Contractor a comprehensive, interconnecting wiring diagram, which shall indicate all terminal connections for items such as the boilers, Emergency Shutdown Switch, Induced Draft Fan controls, combustion air damper, Boiler Control Panel and any other electrically-power devices directly related to the operation of the boilers.

E. The boiler supplier contractor shall also be responsible for physically wiring all control devices described above with in the boiler room. The wiring responsibility shall begin at the transition point where the Electrical Contractor provides power wiring in the boiler room. The boiler supplier and BMS contractor shall assume all responsibility in resolving any conflicts within the overall wiring schematics as they pertain to the boiler room. The boiler supplier control wiring pertains only to the components/systems within their scope of supply. All other boiler room control wiring, including SCADA system and interface to plant master is by the BMS Contractor.

3.3 COORDINATION

A. The equipment supplier shall provide all required on site time to coordinate, checkout and confirm BMS communication interface operation to the satisfaction of the project BMS contractor. On site visits shall be scheduled by the BMS contractor through the mechanical contractor as appropriate for the equipment to which the BMS is being interfaced.

B. The equipment supplier shall also provide all required on site time to coordinate, checkout and confirm BMS communication interface operation to the satisfaction of the project Commissioning Agent. On site visits shall be scheduled by the Commissioning Agent through the mechanical contractor as appropriate for the equipment to which the BMS is being interfaced

3.4 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 steam and feedwater to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

E. Install piping from safety relief valves to the outdoors.

F. 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.

3.5 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 Boiler Management System (BMS) for remote monitoring and control of boilers.

D. Furnish and install control wiring in accordance with the Electrical Specifications.

3.6 NETWORK CONNECTIONS

A. Connect LAN/WAN network cable to boiler controls to provide connectivity for remote monitoring through plant boiler control system. The new plant boiler control system shall be integrated with the new DDC control system.

END OF SECTION 23 5239

DIVISION 26

ELECTRICAL

SECTION 26 0500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 EXECUTION OF THE WORK

A. The scope of work shown on the drawings and in these specifications, Division 26, 27 and 28 are all a part of this contract and shall be included in the base bid unless otherwise noted.

B. These Specifications call out certain duties of the Electrical Contractor. They are not intended as a material list of items required by the Contract.

C. These divisions of the Specifications cover the electrical systems of the project. It includes work performed by the electrical trades as well as trades not normally considered as electrical trades.

D. Provide all items and work indicated on the Drawings and all items and work called for in the Specifications in accordance with the conditions of Contract (Division 1 General Requirements Documents). This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor, consumable items, fees, licenses, etc., necessary to provide complete systems. Perform start-up and checkout on each item and system to verify the systems are fully operable.

E. Comply with all provisions of the Contract Documents including Division 1, General Conditions, and Supplementary General Conditions of the Specifications.

F. Certain terms such as "shall, provide, install, complete, start up" are not used in some parts of these Specifications. This does not indicate that the items shall be less than completely installed or that systems shall be less than complete.

G. Examine and compare the Electrical Drawings and Specifications with the Drawings and Specifications of other trades, and report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the work. At time of bid the most stringent requirements must be included in said bid. Install and coordinate the electrical work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interferences in a manner approved by the Engineer. All changes required in the work of the Contractor caused by neglect shall be corrected at the expense of the Contractor.

H. It is the intent of the drawings and specifications to provide a complete workable system ready for the Client Agency's operation. These specifications are equipment and performance specifications. Items described or called out in the specification but not shown on the drawings are considered to be part of the project. Any item not specifically shown on the drawings or called for in the specifications, but normally required to conform to the intent are to be considered a part of the contract. Installation of the equipment shall be in accordance with the N.E.C., manufacturer recommendation, and industry standards.

I. All material furnished by the Contractor shall be new and unused (temporary lighting and power products are excluded) and free from defects. All materials used shall bear the Underwriters Laboratory, Inc label provided a standard has been established for the material in question.

J. All products and materials to be new, clean, free of defects and free of damage and corrosion.

K. No exclusion from, or limitation in, the symbolism used on the Drawings for electrical work or the languages used in the Specifications for electrical work shall be interpreted as a reason for omitting accessories necessary to complete any required system or item of equipment.

L. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.

M. Except for conduit, conduit fittings, outlet boxes, wire and cable, all items of equipment or material shall be the product of one manufacturer throughout. Multiple manufacturers will not be permitted.

1.3 COORDINATION OF THE WORK

A. Certain materials will be provided by other trades. Examine the Contract Documents to ascertain these requirements.

B. Carefully check space requirements with other trades and the physical confines of the area to ensure that all material can be installed in the spaces allotted thereto including finished suspended ceilings. Make modifications thereto as required and approved.

C. Transmit to other trades all information required for work to be provided under their respective sections in ample time for installation.

D. Wherever work interconnects with work of other trades, coordinate with other trades to ensure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.

E. Due to the type of the installation, a fixed sequence of operation is required to properly install the complete systems. Coordinate, project and schedule work with other trades in accordance with the construction sequence.

F. The locations of lighting fixtures, outlets, panels and other equipment indicated on the Drawings are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed in consequence of increase or reduction of the number of outlets, or in order to meet field conditions or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.

G. Exercise particular caution with reference to the location of panels, outlets, switches, etc., and have precise and definite locations approved by the Engineer before proceeding with the installation.

H. The Drawings show only the general run of raceways and approximate location of outlets. Any significant changes in location of outlets, cabinets, etc., necessary in order to meet field conditions shall be brought to the immediate attention of the Engineer and shall receive approval before such alterations are made. All such modifications shall be made without additional cost to the Client Agency.

I. Obtain from the Engineer in the field the location of such outlets or equipment not definitively located on the Drawings.

J. Circuit "tags" in the form of arrows are used where shown to indicate the home runs of raceways to electrical distribution points. These tags show the circuits in each home run and the panel designation. Show the actual circuit numbers on the finished record tracing and on panel directory card. Where circuiting is not indicated, the Electrical Contractor must provide required circuiting in accordance with the loading indicated on the drawings and/or as directed.

K. The Drawings generally do not indicate the exact number wires in each conduit for the branch circuit wiring of fixtures, and outlets, or the actual circuiting. Provide the correct wire size and quantity as required by the indicated circuiting and/or circuit numbers indicated and control wiring diagrams, if any, specified voltage drop or maximum distance limitations, and the applicable requirements of the NEC.

L. Adjust locations of conduits, panels, equipment, pull boxes, fixtures, etc. to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each raceway prior to installation.

1. Right of way: lines which pitch to have the right-of-way over those which do not pitch. For example: steam, condensate, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
2. Make offsets, transitions and changes in direction in raceways and as required to maintain proper head room in pitch of sloping lines whether or not indicated on the Drawings.

M. Whenever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.

N. Contractor shall furnish services of experienced Superintendent, who shall be in constant charge of all work, and who shall coordinate his work with the work of other trades. No work shall be installed before coordinating with other trades.

1.4 EXAMINATION OF SITE

A. Prior to submitting of bids, the Contractor shall visit the site of the job and shall familiarize himself with all conditions affecting the proposed installation and shall make provisions as to the cost thereof. Failure to comply with the intent of this paragraph will in no way relieve the Contractor of performing all necessary work shown on the Drawings.

1.5 PROGRESS OF WORK

A. The Contractor shall order the progress of his work so as to conform to the progress of the work of other trades and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting from the defective or ill-timed work performed under this section shall be borne by the Contractor.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Ship and store all products and materials in a manner which will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair. Any such repairs shall be subject to review and acceptance of the Engineer.

B. Delivery of Materials: Deliver materials (except bulk materials) in manufacturer's unopened container fully identified with manufacturer's name, trade name, type, class, grade, size and color.

C. Storage of Materials, Equipment and Fixtures: Store materials suitably sheltered from the elements, but readily accessible for inspection by the Engineer until installed. Store all items subject to moisture damage in dry, heated spaces.

1.7 EQUIPMENT ACCESSORIES

A. Establish sizes and location of the various concrete bases required. Coordinate with General Contractor and provide all necessary anchor bolts together with templates for holding these bolts in position.

B. Provide supports, hangers and auxiliary structural members required for support of the work.

C. Furnish and set all sleeves for passage of raceways through structural, masonry and concrete walls and floors and elsewhere as will be required for the proper protection of each raceway and passing through building surfaces.

D. Wall mounted equipment, total weight of 100 pounds or less, may be directly secured to wall by means of steel bolts. Maintain at least 1" air space between equipment and supporting wall. Groups or arrays of equipment, with total weight of more than 100 pounds, shall be mounted on adequately free standing sized steel angles, channels, or bars. Prefabricated steel channels providing a high degree of mounting flexibility, such as those manufactured by Kindorf, Globe-Strutt and Unistrut, may be used for mounting arrays of equipment.

1.8 CUTTING, PATCHING, ETC.

A. The work shall be carefully laid out in advance. Where Cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of raceway, outlets or other equipment, the work shall be carefully done. Any damage to the building, piping, equipment or defaced finish plaster, woodwork, metalwork, etc. shall be repaired by skilled mechanics of the trades involved at no additional cost to the Client Agency.

B. The Contractor shall do no cutting, channeling, chasing or drilling of unfinished masonry, tile, etc., unless he first obtains permission from the Engineer. If permission is granted, the Contractor shall perform this work in a manner approved by the Engineer.

C. Where conduits, outlet, junction, or pullboxes are mounted on a painted surface, or a surface to be painted, they shall be painted to match the surface. Whenever support channels are cut, the bare metal shall be cold galvanized.

D. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs will be provided by the various trades in their respective materials. The trade requiring them to properly locate such openings and be responsible for any cutting and patching caused by the neglect to do so.

1.9 NOMINAL VOLTAGES (UNLESS OTHERWISE NOTED)

A. Primary distribution: 2400 volt, 3 phase, 3 wire.

B. Secondary distribution: 208Y/120 volt, 3 phase, 4 wire.

1.10 MOUNTING HEIGHTS

A. Unless otherwise noted or required because of special conditions, locate outlets as follows:

1. Heights listed are from finished floor to center of device. Verify exact locations with the Engineer before installation.

a. Wall switch outlets ..... 40"
b. Bracket outlets ..... 7'- 0" to bottom
c. Convenience outlets (general) ..... 18"
d. Convenience outlets (mechanical areas) ..... 4' - 0"
e. Panelboard and distribution cabinet to top ..... 6' - 6"
f. Fire alarm audio unit ..... Lower of 80" AFF or 6" below ceiling
g. Fire alarm visual unit ..... 80" to bottom or 96" to top AFF
h. Fire alarm stations ..... 40" to top

1.11 CLEANING UP

A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc. resulting from the installation of work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean, subject to the Architect's instructions, which shall be promptly carried out.

B. Contractor shall clean all fixtures and equipment at the completion of the project.

C. All switchboards, panelboards, wireway, trench ducts, cabinets, enclosures, etc. shall be thoroughly vacuumed clean prior to energizing equipment at the completion of the project. Equipment shall be opened for observation by the Architect as required.

1.12 WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings. Perform work so as to maintain any warranties currently in effect.

B. If this Contractor penetrates any walls or surfaces after they have been waterproofed, this Contractor shall restore the waterproof integrity of that surface at the expense of this Contractor and as directed by the Architect.

1.13 PRODUCTS

A. If products and materials are specified or indicated on the drawings for a specific item or system, use those products or materials. Where noted in other sections of this specification, equipment has been specified for a specific performance and substitutions are not permitted. If products and materials are not listed in either of the above, use first class products and materials, subject to approval of Shop Drawings where Shop Drawings are required or as approved in writing where Shop Drawings are not required.

1.14 OMISSIONS FROM THE DRAWINGS

A. Should a Bidder find discrepancies in or omissions from the drawings or specifications or be in doubt as to their meaning, he shall notify the Architect before submitting his proposal. The Architect will in turn, send written instructions to all Bidders. Neither the Architect nor the Client Agency will be responsible for oral instructions. If the Contractor fails to comply with this requirement, he shall accept the Engineer's interpretations as to the intended meaning of the drawings and specifications.

1.15 EXECUTION

A. Follow manufacturer's instructions for installing, connecting, and adjusting all equipment. Provide one copy of such instructions to the Architect before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Provide all special supports, connections, wiring, accessories, etc.

B. Use mechanics skilled in their trade for all work.

C. Clean all items before and after installation. Clean up all debris.

D. Perform all tests required by local authorities in addition to tests specified herein, such as life safety systems.

E. Applicable equipment and materials to be listed by Underwriters' Laboratories and manufactured in accordance with ASME, NEMA, ANSI or IEEE standards and as approved by local authorities having jurisdiction.

F. Before commencing work, examine all adjoining, underlying, etc., work on which this work is in any way dependent for perfect workmanship and report any condition which prevents performance of first class work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

1.16 VERIFICATION OF ELECTRICAL REQUIREMENTS FOR EQUIPMENT FURNISHED BY OTHERS

A. Prior to the installation of wiring systems for any equipment furnished by others, this contractor shall verify that the electrical requirements of the equipment match those shown on the electrical drawings by examining the approved shop drawings of that equipment. Any discrepancies shall be immediately reported to the engineer.

B. If the contractor fails to comply with this requirement, he shall be responsible for any additional costs incurred at no additional cost to the Client Agency.

1.17 PROTECTION OF BUILDING FIRE/SMOKE BARRIERS

A. Passages of conduit through fire barriers and/or smoke barriers shall be protected as follows:

1. The space between the penetrating item and the fire barrier and/or smoke barrier shall be filled with a material capable of maintaining the fire/smoke resistance of the barrier or be protected by an approved device designed for the specific purpose.
2. Where the penetrating item uses a sleeve to penetrate the fire and/or smoke barrier the sleeve shall be solidly set in the fire/smoke barrier and the space between the item and the sleeve shall be filled as described above.
3. Fire barriers shall include 1-hour, 2-hour, and 3-hour rated floors and walls. Refer to architectural plans for location of fire barriers and smoke barriers and provide protection required to maintain ratings in accordance with all codes.

4. Approved fill material for fire barriers shall be packed mineral wool, with ASTME-136 rating and 3M Fire Barrier caulk. Coordinate sealing of all openings with requirements of Division 7 of this specification.
5. Perform work in accordance with the appropriate UL Ratings.
6. Product Data: Provide manufacturer's specifications, recommendations and installation instructions for each application.

1.18 CODES AND FEES

A. General: Comply with Codes in accordance with the Contract Documents.

B. The electrical installation shall be in compliance with the requirements of OSHA, NEC and the rules, regulations and requirements of the power company supplying power to the building.

C. The electrical installation shall comply fully with all township, county and state laws, ordinances and regulations applicable to electrical installations.

D. All equipment shall be equal to or exceed the minimum requirements of NEMA, IEEE and UL.

E. Should any change in Drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify Architects prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instruction of the Architect and at no additional cost to the Client Agency.

F. The local fees and permits and services of inspection authorities shall be obtained and paid for by the Contractor. The Contractor shall cooperate fully with local utility companies with respect to their services.

G. Certificate of Inspection and approval shall be procured and paid for by this Contractor from an approved certified inspection agency.

1.19 GUARANTEE

A. General: Provide a Guarantee in accordance with the Contract Documents.

B. Submit a single guarantee stating that all portions of the work are in accordance with Contract requirements. Guarantee all work against faulty and improper material and workmanship for a period of one (1) year from date of final acceptance by the Client Agency, except that where guarantees or warranties for longer terms are specified herein, such longer term to apply. Within 24 hours after notification, correct any deficiencies which occur during the guarantee period at no additional cost to Client Agency, all to the satisfaction of the Client Agency and Architect. Obtain similar guarantees from manufacturers, suppliers and subtrade specialists.

1.20 DISPOSAL

A. All electrical items not designated by the Client Agency for his use to be properly disposed of according to local, state and Federal regulations.

B. Items containing polychlorinated biphenyl (PCB) to be removed, transported and disposed of according to Federal Toxic Substances Control Act (TSCA). Contractor to submit certification that these items have been properly disposed.

1.21 RECORD (AS-BUILT) DRAWINGS

A. The 0.4 Contractor shall maintain a complete PDF set of the Contract Drawings at the site and shall record each deviation in his work (in red lines and text using mark-up software) from that indicated on the Contract Drawings. Deviations shall be clearly and accurately recorded so that the Professional can prepare final record (as-built) drawings using the 0.4 Contractor's marked-up PDF's. Dimensions shall be recorded using permanent reference points such as columns, building walls and like items. These record drawings shall be submitted to e-Builder for review and approval by the Professional prior to final acceptance.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 26 0500

SECTION 26 0500.10 - ABBREVIATIONS AND DEFINITIONS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. Utilize the following abbreviations and definitions for discernment within the Drawings and Specifications.

1. Abbreviations

a. NEC National Electrical Code
b. OSHA Occupational Safety and Health Act
c. ANSI American National Standards Institute
d. NFPA National Fire Protection Association
e. ASA American Standards Association
f. IEEE Institute of Electrical and Electronics Engineers
g. NEMA National Electrical Manufacturers Association
h. UL Underwriters' Laboratories, Inc.
i. IES Illuminating Engineering Society
j. ICEA Insulated Cable Engineers Association
k. ASTM American Society of Testing Materials
l. ETL Electrical Testing Laboratories, Inc.
m. CBM Certified Ballast Manufacturers
n. EIA Electronic Industries Association
o. OEM Original Equipment Manufacturer
p. ADA Americans with Disabilities Act

2. Definitions

a. "PROVIDE" means to supply, purchase, transport, place, erect, connect, test and turn over to Professional, complete and ready for regular operation, the particular work referred to.
b. "INSTALL" means to join, unite, fasten, link, attach, set up or otherwise connect together before testing and turning over to Client Agency, complete and ready for regular operation, the particular work referred to.
c. "FURNISH" means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application for the particular work referred to.
d. "WIRING" means the inclusion of all raceways fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such work.
e. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.
f. "AS DIRECTED" means as directed by the Professional or his representative.
g. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 26 0500.10

SECTION 26 0500.15 - WORK INCLUDED

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. General: Provide the work included in accordance with the Contract Documents.

B. Provide all labor, materials, equipment, tools, appliances, auxiliaries, services, hoisting, scaffolding, support, supervisions, Project Record Documents, and perform all operations noted in the Documents. Perform all operations for the furnishing and installation of the complete electrical system, including, but not limited to, the work described hereinafter. The work shall meet or exceed the latest codes, regulations and requirements of the state and local community.

C. The electrical work is shown schematically on the Drawings to indicate the general system arrangement and configuration. The work of this Division shall include coordination with the work of other Divisions of the Specifications and the Contract Documents so as to provide complete and operational systems capable of being readily operated and maintained, to the Client Agency’s satisfaction.

D. The work includes, but is not limited to the following:

1. Installation of new Medium-Voltage Substation Transformer
2. Installation of new low voltage switchgear
3. Alterations and additions to existing power distribution system
4. Alterations to existing building facilities
5. Grounding system
6. Connection to HVAC equipment
7. Short circuit/coordination/flash hazard study
8. Fire Alarm System

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 26 0500.15

SECTION 26 0500.17 - REVIEWS AND ACCEPTANCES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUBSTITUTION OF MATERIALS OR EQUIPMENT

A. Reference shall be made to Division 012500 "Substitutions Procedures", for substitution of material or equipment in this Division of the Specifications.

1.3 SHOP DRAWINGS

A. Prepare and submit detailed shop drawings for materials, systems and equipment as listed herein, including locations and sizes of all openings in floor decks, walls and floors.

B. The work described in any shop drawing submission shall be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper condition with all trades on the job. Each submitted shop drawing shall include a certification that all related job conditions have been checked and that no conflict exists.

C. All drawings shall be submitted sufficiently in advance of final requirements to allow ample time for checking and resubmittal as may be required. All submittals shall be complete and contain all required and detailed information.

D. Acceptance of any submitted data or shop drawings for material, equipment apparatus, devices, arrangement and layout shall not relieve Contractor from responsibility of furnishing same of proper dimensions and weight, capacities, sizes, quantity, quality and installation details to efficiently perform the requirements and intent of the contract. Such acceptance shall not relieve contractor from responsibility for errors, omissions or inadequacies of any sort on submitted data or shop drawings.

E. Each shop drawing shall contain job title and reference to the applicable drawing and specification article.

1.4 SHOP DRAWING SUBMITTALS

A. Certified Submittals

1. All 0.4 materials, devices, appliances and equipment shall be labeled and listed by a certified testing laboratory or agency.

B. Submit for the Professional’s approval shop drawings of the following and any other shop drawings requested:

1. Switchboard
2. Substation Transformer
3. Panelboards
4. Safety switches

5. Wiring devices
6. Surge protective devices
7. Fire Alarm System

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 26 0500.17

SECTION 26 0500.19 - MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. General: Provide maintenance manuals in accordance with the Contract Documents.

1.3 SUBMITTALS

A. Provide one (1) copy of each manual.

B. All submittals to be submitted and processed through eBuilder.

C. Manuals to be completed and in Client Agency's hands prior to turning building over to Client Agency and at least 10 days prior to instruction to operating personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS' LITERATURE

A. General: Provide manufacturers' literature on all items of equipment and components as regularly published by the respective manufacturers for proper preventative and comprehensive maintenance.

PART 3 - EXECUTION

3.1 PROVIDE MAINTENANCE MANUALS INCLUDING BUT NOT LIMITED TO THE FOLLOWING:

A. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.

B. Operating instructions for complete system including:

1. Normal starting, operating, and shut-down.
2. Emergency procedures for fire or failure of major equipment.

C. Maintenance instructions including:

1. Proper lubricants and lubricating instructions for each piece of equipment, and date when lubricated.
2. This shall be a separate list in addition to manufacturers' data.
3. Necessary cleaning, replacement and/or adjustment schedule.

D. Manufacturers' data on each piece of equipment including:

1. Installation instructions.
2. Drawings and specifications.
3. Parts list, including recommended items to be stocked.
4. Complete wiring diagrams.
5. Marked or changed prints locating all concealed parts and all variations from the original system design.
6. Test and inspection certificates.

END OF SECTION 26 0500.19

SECTION 26 0500.22 - EQUIPMENT WIRING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.1 DESCRIPTION

A. General: Provide final connections to equipment and coordinate same in accordance with the Contract Documents.

B. Equipment to receive final connections shall include, but not be limited to the following:

1. Mechanical equipment
2. Miscellaneous equipment

1.2 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. American National Standard Safety Code for Elevators, Dumbwaiters and Moving Walks (ANSI A17.2).

1.3 EXAMINATION OF DOCUMENTS

A. Prior to the submitting of bids, the Contractor shall familiarize himself with all conditions affecting the proposed installation of equipment requiring 0.4 connections and shall make provisions as to the cost thereof. Failure to comply with the intent of this paragraph shall in no way relieve the Contractor of performing all necessary work required for final 0.4 connections and equipment.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 MECHANICAL EQUIPMENT

A. All power wiring and connections for all motors including starters, controllers, and breakers as indicated on the drawings and the riser diagrams shall be furnished and installed under this section of the specifications.

B. Motors shall be connected in a neat and skillful manner. Ones delivered with terminal boxes that are inadequate shall be equipped with special boxes that suit the conditions.

C. In general, rigid conduit or tubing shall be used, but motors that require movement or ones that would transmit vibration to conduit shall be wired with liquid tight flexible steel conduit not over 18" long.

D. All motors shall be grounded with a green covered ground wire run inside the conduit and connected to motor frame on one end and to grounding system on the other end.

E. The location of motors, starters and control equipment and the arrangement to be followed shall be determined on the job jointly by the Contractor whose equipment is involved, this Contractor and the Professional.

F. Starting equipment shall be either wall mounted or free standing, as best suits conditions. If free standing, this Contractor shall make and install a suitable frame of structural steel to accommodate it.

G. Furnish and install one motor snap switch of the proper size for disconnect of each single phase motor indicated on the drawings.

3.2 CONTROL WIRING

A. Control wiring for 0.2 and 0.3 equipment will be furnished and installed by 0.3 and 0.2 Contractor as Specified in Divisions 22 and 23.

B. All control wiring in Divisions 22 and 23 is the responsibility of the contractor who provides the particular equipment. Control wiring includes the providing of all required motor controls, relays, pilot devices, all related raceway systems, all related conductors and all final connections other than three phase power connections.

C. For single phase equipment provided under 0.2 and 0.3 Contracts, this Contractor shall provide single phase feeders and make final connection through the control device.

D. All other control wiring required by other Divisions of the Specifications shall be furnished and installed by this Contractor. Unless specifically indicated on the drawings or specified hereinafter to the contrary, all control devices such as starters, pushbuttons, limit switches, etc., are furnished under other Divisions of the Specifications. This Contractor shall receive and store all 0.4 equipment to be installed by him. Conduit and layout and arrangement of control wiring shall be done by this Contractor.

3.3 EQUIPMENT CONNECTIONS

A. This contractor shall make final connections to all 0.4 equipment. Coordinate with equipment supplier for size and location of all final connections. Contractor to match receptacle with plugs of equipment supplied by others.

END OF SECTION 26 0500.22

SECTION 26 0508 - TESTING, ACCEPTANCES, AND CERTIFICATIONS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. General: Complete testing of equipment and systems shall be provided throughout in accordance with the Contract Documents.

1.3 STANDARDS

A. Except as modified by governing codes and by the Contract Documents comply with the latest applicable provisions and the latest recommendations of the following:

1. Industry standards shall apply except as otherwise specified.

1.4 APPLICABLE CODES, STANDARDS AND REFERENCES

A. All inspections and tests shall be in accordance with the following applicable codes and standards except as provided otherwise herein.

1. National Electrical Manufacturer's Association – NEMA
2. American National Standards Institute – ANSI
3. Institute of Electrical and Electronic Engineers – IEEE
4. National Electrical Code – NEC
5. National Fire Protection Association – NFPA
6. American Society for Testing and Materials – ASTM
7. Insulated Power Cable Engineers Association – IPCEA
8. Association of Edison Illuminating Companies – AEIC
9. Occupational Safety and Health Administration – OSHA
10. State and local codes and ordinances
11. Applicable Independent Testing Associations Specifications

B. All inspections and tests shall utilize the following references:

1. Project design specifications
2. Project design drawings
3. Manufacturer's instruction manuals applicable to each particular apparatus.

1.5 SUBMITTALS

A. The test report shall include the following:

1. Summary of project
2. Description of equipment tested
3. Description of test
4. Test results
5. Conclusions and recommendations
6. Appendix, including appropriate test forms

7. List of test equipment used and calibration date
8. Conditions for future access to secured computer database of all Test Data.

B. Furnish and upload one copy of the completed report to eBuilder no later than 30 days after completion of the project, unless directed otherwise.

1.6 SAFETY AND PRECAUTIONS

A. Safety practices shall include, but are not limited to, the following requirements:

1. Occupational Safety and Health Act of 1970 – OSHA 29CFR 1910.269
2. National Fire Protection Association – NFPA 70E
3. Applicable state and local safety operating procedures.

B. All tests shall be performed with apparatus de-energized except where otherwise specified.

C. The engineering service testing group's lead test Professional for the project shall be a designated safety representative and shall be present on the project and supervise testing operations and safety requirements.

D. Power circuits shall have conductors shorted to ground by a hotline grounded device approved for the purpose in accordance with the appropriate test procedures.

E. In all cases, work shall not proceed until the safety representative has determined that it is safe to do so.

F. The engineering service testing group shall have available sufficient protective barriers and warning signs, where necessary, to conduct specified tests safely.

G. The Client Agency's safety procedures shall be reviewed and understood by the engineering service testing group personnel.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all labor, premium labor and materials required by shop and field testing as specified in the Contract Documents and as required by the authorities having jurisdiction.

2.2 SYSTEMS

A. The following systems are to be tested, inspected and certified.

1. Wire and Cable (600 Volts and Below)

a. Inspect all splices and terminations and make mechanically and electrically tight during a fifteen (15) day period immediately prior to final acceptance of the work.
b. Insulation System – To ensure integrity of the cable insulation system after shipping, site storage, and pulling through conduit an insulation resistance test will reveal insulation deformities and moisture in the cable that otherwise might cause an untimely premature cable failure possibly damaging equipment or personnel. Perform the following on all customer power cables to and from main switchboard. This would include cables from utility transformer to MSB and cables from MSB to all secondary switchboards or distribution panels.
c. Visually inspect visible portion of cables for observable defects.

d. Ensure all solid-state devices are disconnected from the system prior to meggering. Typically but not all-inclusive would be Meters, trip units with voltage sensing, and SPD units.
e. Isolate cables by opening breakers. Meggering thru equipment like motors or transformers will produce erroneous readings.
f. Perform insulation-resistance tests on each line and load cable, phase-to-phase, phase-to-ground, phase-to-neutral and neutral-to-ground in each conduit. Megger at 1000 VDC for 600 volt cable and 500 VDC for 300 volt cable for one minute.
g. Insulation resistance shall be above 100 ohms and preferably above one megohm.
h. Ensure cable termination connections are tight after testing.

2. Motors

a. Test all motors under load and verify that motor rotation is correct.

3. Switchboard Acceptance Testing For Main Switchboard(s)

a. Examine the Main switchboard(s), including breakers, and accessories for:

1) Doors, panels, and sections for alignment, dents, scratches, fit, and missing hardware
2) Shipped loose and shipped short components.
3) Shipping damage
4) Loose or obviously damaged components.
5) Proper identification.
6) Physical damage from installation.
7) If the unit was placed in temporary storage, verify and record that proper procedures were observed. Remove temporary heater wiring and shipping braces.

b. Inspect

1) Shipping Splits to insure that all bus connections were properly connected and all control wiring splits have been properly terminated.
2) Inspect all grounding connections for cleanliness and alignment.
3) Main Bonding Jumper for proper size and termination (Refer to NEC Article 250, Section 250-102, Equipment Bonding Jumpers).
4) Insulators for evidence of physical damage or contaminated surfaces.
5) Surge Arrester and/or Surge Suppression size, type, installation and connection to determine if they are in accordance with the drawings (Refer to NEC Article 280)
6) Control power & instrument transformers, if applicable.
7) Wiring for damaged insulation, broken leads, tightness of connections, proper crimping, and overall general condition.

c. Verify Structure, Grounding, Cables and Bus Assembly

1) Anchorage (per local codes, wind and seismic considerations).
2) Required area clearances, correct alignment and cleanliness.
3) Verify the grounding electrode conductor is properly sized (in accordance with NEC Article 250, Table 250-66) and terminated.
4) The proper grounding of instruments, panels and connections (Refer to NEC Article 250, Part J, Sections 250-170 through 250-178).
5) That conductors are properly identified (as applicable).
6) Cable termination tightness.

7) That all cables have been properly installed, routed and supported and are clear of energized parts.
8) That conduits and conduit bushings are correctly installed.
9) Tightness of accessible bolted 0.4 connections, especially shipping splits, by calibrated torque-wrench method in accordance with manufacturers published data.

d. Verify Control and Instrumentation

1) That all VT and CT ratios properly correspond to drawings and that polarity is correct.
2) That shorting screws and bars are removed from CT's and terminal blocks as required.
3) That primary and secondary fuse ratings or circuit breakers match drawings.
4) Meter scaling and type match drawings.

e. Set Meter, Relay, and Breaker Trip settings

1) The meter, protective relay, breaker settings (and PFC choices) must be supplied from a Power System Study performed by the Professional service group prior to commissioning.
2) Calculations and settings are to take into account coordination and protection that might be non-intuitive. i.e., a 5000 amp breaker may be set to a 3000 amp trip point to match a utility primary fuse. While this may not seem right at first, tripping the main first rather than a normally smaller utility transformer may avoid blowing a primary utility fuse, and avoid the resulting single phasing and the downtime of waiting for the utility response. It would be far simpler and faster to reset main and reenergize quickly, not to mention the loss of equipment from single phasing.
3) Set meter, relay, & breaker trip setting per above study.

f. Ductor Testing

1) Inspect shipping splits for mechanical connection assuring adequate surface contact.
2) Ground bonding & shipping splits shall be tested with ductor tester (Digital low ohm resistance meter) to insure connection is a low resistance connection. Test from one fixed bus to adjacent fixed bus through the shipping split connector to measure both connection points.
3) Microhm values shall not vary more than 50% from other phase readings and meet the manufactures published data based on bus size, ampacities and material.

g. Test of the Phase Loss and Undervoltage Relay

1) Test the phase loss relay, either separate or integral to the multimeter, to activate contact.
2) Test the undervoltage relay, either separate or integral to the multimeter, to activate contact.
3) If contact is hooked to the Capacitor trip & Shunt trip combo on main breaker, insure main breaker trips.
4) If contact reports to energy management system, insure energy management system receives loss of phase/voltage signal.

h. Ground Fault Testing

1) Inspect switchboard main bonding jumper for proper size and termination on source side of neutral disconnect link.
2) Inspect Grounding electrode conductor to assure proper size and secure termination to ground bus.
3) Inspect switchboard neutral bus downstream of the neutral disconnect link to verify the absence of ground connections.
4) Set Ground fault setting per calculations in E above.
5) Verify Ground Fault System Performance for correct response of the circuit-interrupting device by secondary (or primary if local inspector requires) ground sensor current injection. Record ground fault pickup current. Verify breaker trips and indicator works.
6) Verify Ground fault does not pick-up at 90% of pickup setting.
7) Record settings, results, and any other notations on the Low Voltage Breaker data form.

PART 3 - EXECUTION

3.1 GENERAL

A. Notify the Professional seven (7) days prior to the testing dates. If the Professional so elects not to witness a specific test a statement of certification must be forwarded to the Professional for his approval.

B. Conduct tests at a time agreeable to the Professional. Provide premium labor as necessary.

C. Products which are found defective or do not pass such tests shall be removed and replaced at the Contractor's expense. Tests shall be repeated.

D. Conduct all test required by the authorities having jurisdiction.

3.2 RESTORATION OF EQUIPMENT AND REPORTS

A. Before Energizing

1. Remove and account for all test equipment, jumper wires, and tools used during testing.
2. Remove and account for safety grounds and tools.
3. Replace all barriers and covers, close all doors, and secure all latches.
4. Remove safety locks and tags.
5. Ensure all adjustable meters, relays and trip devices are properly set in accordance with the coordination study.
6. Apply testing label to equipment

B. Note corrective actions taken, deficiencies, recommendations and any general comments.

C. Finish recording data on test forms, completely filling in the blanks. Enter into electronic database as required in section 1.4. E

D. Turn in 3 copies of report to Professional for approval.

3.3 FOLLOW UP TESTING

A. Included in above cost as part of original project.

B. One month prior to the expiration of the factory warranty schedule & perform a thermal scan of all breaker to cable, breaker, bus connections, cable to panel chassis. Scope is to include main transformer connections, main switchboard, all secondary switchboards, transformers, and panels. Tests are to be done with building normal loaded for 2 hours, not with partial or unloaded condition.

C. Thermal scan temperatures shall be evaluated as follows (based on comparable size or adjacent phases and loaded breakers, bus connections, and terminations)

1. 1-3 degrees C rise, Investigate as to the cause of temp rise.
2. 4 – 15 degree C rise, Repair as soon as possible.
3. 16 or higher degree C rise, Repair immediately.

D. Ensure that all bus and breaker to cable connections are tight.

E. Note corrective actions taken, deficiencies, recommendations and any general comments.

F. Finish recording data on test forms, completely filling in the blanks.

G. Turn in 3 copies of report to Professional for approval.

END OF SECTION 26 0508

SECTION 26 0519 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 Specification Section, apply to this Section.

1.3 SUMMARY

A. General: Provide 600 volt wire and cable in accordance with the Contract Documents.

1.4 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Underwriters Laboratory Standard No. UL 467, UL 486c

a. ASTM
b. IPECA

2. Terminal Blocks

a. UL-1059

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

A. General

1. Provide wire with a minimum insulating rating of 600 volts, except for wire used in 50 volts or below applications for control of signal systems use 300 volt minimum or 600 volt where permitted to be incorporated with other wiring systems.

B. Conductor

1. 0.4 grade, annealed copper fabricated in accordance with ASTM standards. Minimum size number 12 for branch circuits; number 14 for control wiring.
2. The conductors shown on the drawings are copper, except as noted otherwise.

C. Stranding and Number of Conductors

1. Number 12 and number 10 solid.
2. Cables larger than number 10, stranded in accordance with ASTM Class B stranding designations.

3. Control wires stranded in accordance with ASTM Class B stranding designations.
4. Cables, multi-conductor unless otherwise noted for low tension systems.

D. Insulation

1. Type THWN/THHN insulation suitable for use in wet locations up to 75 degrees Centigrade. Use for lighting, receptacle and motor circuits and for panel and equipment feeders.
2. Type THHN – Flame retardant: Heat-resistant thermoplastic insulation, nylon jacket rated for 90 degrees Centigrade operation. Use for lighting branch circuit wiring installed and passing through the ballast channels of fluorescent fixtures, wiring in metal roofdecks in or near roof insulation, in attic or joist spaces, or in raceways exposed to the sun.
3. Type XF – Crosslinked polyolefin insulated heat-resistant wire suitable for 150 degrees Centigrade operation. Use for fixture wiring or any wiring within 3 feet horizontally or 10 feet above any furnace, boiler or similar appliance.

E. 2-Hour Fire Rated Wiring System (MI)

1. Cable shall be 2-hour rated, UL rated with copper sheath. Cable shall be factory assembled of one or more conductors insulated with highly compacted magnesium oxide insulation and enclosed in a seamless, liquid- and gas-tight continuous copper sheath.
2. Conductors shall be solid, high 0.4 conductivity copper with cross section corresponding to the standard N.E.C. AWG sizes.
3. Insulation shall be of highly compressed magnesium oxide that provided proper spacing for the conductors. Thickness of the insulation shall be at least 55 mils for all 600 volt power or control cables.
4. Cable and installation shall comply with N.E.C. Article 332. Cables must be supported per manufacturers recommendations.
5. Cable shall be Pentair System 1850 or approved equal. Provide shop drawings of cable and fittings.

F. Color Coding

1. Provide consistent color coding of all feeders, sub feeders, motor circuits and the likes as follows:

120/208 Volts Code
Phase A - Black
Phase B - Red
Phase C - Blue
Neutral - White
Ground - Green

2. Color code wiring for control systems installed in conjunction with mechanical and/or miscellaneous equipment in accordance with the wiring diagrams furnished with the equipment. Factory color code wire number 2 and smaller. Wire number 1 and larger may be color coded by color taping of the entire length of the exposed ends.

2.2 CONNECTORS

A. Make connections, splices, taps and joints with solderless devices, mechanically and electrically secure. Protect exposed wires and connecting devices with 0.4 tape or insulation to provide not less than that of the conductor.

B. Branch Circuit wires (Number 10 and smaller): Use any of the following types of terminals and connecting devices:

1. Hand Applied

a. Coiled tapered, spring wound devices with a conducting corrosion-resistant coating over the spring steel and a plastic cover and skirt providing full insulation for splice and wired ends. Screw connector on by hand.

2. Tool Applied

a. Steel cap, with conduction and corrosion resistant metallic plating, open at both ends, fitted around the twisted ends of the wire and compressed or crimped by means of a special die designed for the purpose. Specifically fitted plastic or rubber insulating cover wrap over each connector.

2.3 ELECTRICAL TAPE

A. Specifically designed for use as insulating tape.

2.4 LUBRICANT

A. Use lubricant only where the possibility of damage to conductors exists. Use only a lubricant approved by the cable manufacturer and one which is inert to cable and raceways.

PART 3 - EXECUTION

3.1 WIRE AND CABLE

A. Provide a complete system of conductors in raceway system. Mount wiring through a specified raceway, regardless of voltage application.

B. Drawings do not indicate size of branch circuit wiring. For branch circuits whose length from panel to furthest outlet exceeds 100 feet for 120-volt circuits, use number 10 or larger.

C. Do not install wire in incomplete conduit runs nor until after the concrete work and plastering is completed and moisture is swabbed from conduits. Eliminate splices wherever possible. Where necessary, splice in readily accessible pull, junction, or outlet.

D. Provide cable supports for all vertical risers where required by code.

E. Flashover or insulation value of joints to be equal to that of the conductor. Provide Underwriters Laboratories listed connectors rated at 600 volts for general use and 1,000 volts for use between ballasts and lamps or gaseous discharge fixtures.

F. Use terminating fittings, connectors, etc., of a type suitable for the specified cable furnished. Make bends in cable at termination prior to installing compression device. Make fittings tight.

G. Extend wire sizing for the entire length of a circuit, feeder, etc. unless specifically noted otherwise.

H. Provide a separate neutral conductor for each branch circuit. In the event a common neutral conductor is used, such as in furniture systems, the circuit breaker in the panelboard must be common trip for each phase that uses one neutral conductor.

END OF SECTION 26 0519

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 Specification Section, apply to this Section.

1.3 SUMMARY

A. General: Provide a low impedance grounding system in accordance with the Contract Documents.

1.4 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Underwriters Laboratory Standard No. UL 467
2. ANSI C-1 1978

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install an 0.4 grounding system as indicated on the construction documents and as specified herein.

B. Grounding systems shall be installed in accordance with the requirements of the local authorities, NEC Section 250, and subject to the approval of the Professional.

C. All ground wires and bonding jumpers shall be stranded copper installed in conduit. All ground wires shall be without joints and splices over its entire length.

2.2 GROUNDING SYSTEMS

A. The system neutral shall be grounded at the service entrance only, and kept isolated from grounding systems throughout the building.

B. Each system of continuous metallic piping and ductwork shall be grounded in accordance with the requirements of the NEC Section 250.

C. Metal conduits and portions of metallic piping and duct systems which are isolated by flexible connections, insulated coupling, etc., shall be bonded to the equipment ground with a flexible bonding jumper, or separate grounding conductor.

D. All conduits, metal raceways, boxes, cabinets, etc., installed by this Contractor and all motors and equipment connected shall be properly bonded and grounded.

E. In all feeders and branch circuits install a green colored ground wire to each panel, cabinet, receptacle, motor or piece of control equipment.

F. The green ground wires shall be extended and connected to the ground bus in the panels or equipment enclosure. Neutral wiring system shall not be used for this purpose. Green ground wire shall be connected to all junction or pull boxes through which they pass and to all cabinet and panel enclosures.

G. This ground wire shall be run in same conduit as phase and neutral wires feeding equipment, motor or receptacles and conduit size shall be increased if necessary. This conductor shall be installed whether or not shown on the drawings and shall be sized in accordance with NEC but shall not be smaller than #12 AWG. Motors shall be grounded by a grounding terminal in their connection box. Tie all ground wires together in panels and connect to ground bus in panel cabinet.

H. All 0.4 equipment including lighting fixtures shall be grounded in the same manner as motors. All equipment shall be solidly grounded to the green covered wire and this Contractor shall furnish grounding lugs as required.

PART 3 - EXECUTION

3.1 GENERAL

A. Grounding connections and splices shall be brazed molded exothermic welded, bolted clamp terminal or pressure-connector type. Bolted connections and pressure-connectors shall be used for connections to removable equipment. Brazed connections shall be made where noted on drawings.

END OF SECTION 26 0526

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 Specification Section, apply to this Section.

1.3 SUMMARY

A. Equipment shall be installed on hangers and supports as specified in this section of the specifications.

1.4 SUPPORTS

A. Support work in accordance with the best industry practice and the following.

B. Include supporting frames or racks extending from floor slab to ceiling slab for work indicated as being supported from walls where the walls are incapable of supporting the weight. In particular, provide such frames or racks in electric closets.

C. Include supporting frames or racks for equipment, intended for vertical surface mounting, which is required in a free-standing position.

D. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members. They shall be rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.

E. Nothing, (including outlet, pull and junction boxes and fittings) shall depend on electric conduits, raceways, or cables for support, except that threaded hub type fittings having a gross volume not in excess of 100 cubic inches may be supported from heavy wall conduit, where the conduit in turn is securely supported from the structure within five inches of the fitting on two opposite sides.

F. Nothing shall rest on, or depend for support on, suspended ceilings media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling).

G. Provide required supports and hangers for conduit, equipment, etc., so that loading will not exceed allowable loadings of structure.

1.5 FASTENINGS

A. Fasten electric work to building structure in accordance with the best industry practice and the following:

B. As a minimum procedure, where weight applied to the attachment points is 100 pounds or less, fasten to building elements of:

1. Wood – with wood screws.
2. Concrete and solid masonry – with bolts and expansion shields.
3. Hollow Construction – with toggle bolts.
4. Solid metal – with machine screws in tapped holes or with welded studs.
5. Steel decking or subfloor – with fastenings as specified below for applied weights in excess of 100 pounds.

C. As a minimum procedure, where weight applied to the attachment points exceeds 100 pounds, but is 300 pounds or less, conform to the following:

1. At concrete slabs utilize 24" x 24" x 1/2" steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the tob of slab screen line, where no fill is to be applied.
2. At steel decking or subfloor for all fastenings, utilize through bolts or threaded rods. The tops of bolts or rods shall be set at least one inch below the top fill screen line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or subfloor manufacturer produces specialty hangers to work with his decking or subfloor such hangers shall be utilized.

D. Where weight applied to building attachments points exceeds 300 pounds, coordinate with and obtain approval of Professional and conform to the following:

1. Utilize suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Utilize threaded rods or bolts to attach to bridging members.

E. Floor mounted equipment shall not be held in place solely by its own dead weight. Include floor anchor fastenings in all cases.

F. For items which are shown as being ceiling mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging tying to the building structural elements.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 26 0529

SECTION 26 0533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. General: Provide raceways in accordance with the Contract Documents.

1.3 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Rigid Conduit – RMC

   a. UL Standard UL-6
   b. ANSI C80-1
   c. Federal Specification WW-C-581E

2. Electrical Metallic Tubing – EMT

   a. UL Standard UL-797
   b. ANSI C80-3
   c. Federal Specification WW-C-563

3. Flexible Metal Conduit – FMC

   a. UL Standard UL-1

4. LiquidTight Flexible Metal Conduit – LFMC

   a. UL Standard UL-360

5. Rigid Non-Metallic Conduit – RNC

   a. UL Standard UL-651
   b. ANSI Standard C33.91
   c. Federal Specifications GSA-FSS and W-C1094-A

6. Wireways and Auxiliary Gutters

   a. UL Standard UL-870

7. Metal Clad Cable – MC

   a. UL Standard 1581
   b. Federal Spec J-C-30B

PART 2 - PRODUCTS

2.1 RACEWAY TYPES

A. Rigid Steel Conduit – RMC

1. Rigid steel conduit heavy wall galvanized.

B. Electric Metallic Tubing – EMT

1. Continuous, seamless tubing galvanized or sheradized on the exterior coated on the interior with a smooth hard finish of lacquer, varnish or enamel.
2. All couplings, connectors, etc., used in conjunction with this raceway which are 2 inch in size and smaller shall be watertight compression type. EMT fittings shall be zinc plated steel. With conduits of 2-1/2 inch in size and larger, set screw type couplings are permitted.

C. Flexible Metal Conduit – FMC

1. Single strip, continuous, flexible interlocked double-wrapped steel, galvanized inside and outside forming smooth internal wiring channel.
2. Maximum length: 6 feet.
3. Each section of raceway must contain a bonding wire bonded at each end and sized as required. Provide connectors with insulating bushings.

D. LiquidTight Flexible Metal Conduit – LFMC

1. Same as flexible steel conduit except with tough, inert watertight plastic outer jacket.
2. Cast malleable iron body and gland nut cadmium plated with one-piece brass grounding bushings which thread to interior of conduit. Spiral molded vinyl sealing ring between gland nut and busing and nylon insulated throat.

E. Metal Clad Cable – MC
Non Health Care

1. Type MC cable shall be armored galvanized steel sheath cable with copper conductors and THHN 90 º insulation. Furnish with insulated grounding conductor.

F. Rigid Non-Metallic Conduit – RNC

1. Composed of polyvinyl chloride suitable for 90º C.
2. Raceway, fittings and cement must be produced by the same manufacturer who must have had a minimum of ten (10) years experience in manufacturing the products.
3. Materials must have a tensile strength of 7,000 – 7,200 psi and compressive strength of 9,000 psi.
4. All joints shall be solvent cemented in accordance with the recommendations of the manufacturer. Install expansion fittings per NEC.

G. Wireways and Auxiliary Gutters

1. Of sizes and shapes indicated on the Drawings and as required.
2. Provide all necessary elbows, tees, connectors, adaptors, etc.
3. Hinged cover secured with captive screws.
4. Wire retainers not less than 12 inches on center.

2.2 OUTLET, JUNCTION AND PULLBOXES

A. Provide zinc-coated or cadmium-plated sheet steel outlet boxes not less than 4 inches octagonal or square, unless otherwise noted. Equip fixture outlet boxes with 3/8 inch no-bolt fixture studs where required. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture. Fit outlet boxes in finished ceilings or walls with appropriate covers, set flush with the finished surface. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide Series "GW" (Steel City) tile box, or as accepted, or a 4 inch square box with tile ring in masonry walls which will not be plastered or furred. Where drywall material is utilized, provide plaster ring. Provide outlet boxes of the type and size suitable for the specific application. Where outlet boxes contain two or more 277 volt devices, or where devices occur of different applied voltages, or where normal and emergency devices occur in same box, provide suitable barrier.

B. Construct junction or pullboxes not over 150 cubic inches in size as standard outlet boxes, and those over 150 cubic inches the same as "cabinets" with screw covers of the same gauge metal.

C. Plug any open knockouts not utilized.

D. Provide surface mounted outlet and junction boxes in indoor locations where exposed to moisture and outdoor locations of cast metal with threaded hubs.

PART 3 - EXECUTION

3.1 APPLICATION OF RACEWAYS

A. The following applications must be adhered to except as otherwise required by Code. Raceway not conforming to this listing must be removed by this Contractor and replaced with the specified material at this Contractor's expense.

B.

Raceway Types	Application
Rigid Conduit RMC	1. Where exposed on outside of building or subjected to exterior temperatures and humidity. 2. Where required by codes. 3. All circuits in excess of 600V.
Electrical Metallic Tubing EMT	Use in every instance except where another material is specified.
Flexible Metal Conduit – FMC	Use in dry areas for connections to lighting fixtures in hung ceilings, connections to equipment installed in removable panels of hung ceilings at all transformer or equipment raceway connections where sound and vibration isolation is required.
LiquidTight Flexible Metal Conduit - LFMC	Use in areas subject to moisture where flexible steel is unacceptable at connections to all motors, and all raised floor areas.
Rigid Non-Metallic Conduit – RNC	1. Schedule 40 – Where raceways are in slab in below grade levels, for raceway duct banks. 2. Schedule 80 – For underground raceways outside of the building which are not encased in concrete

Metal-Clad Cable - MC	Use for branch circuit wiring above suspended ceilings or in metal stud walls. Cable shall not be run exposed. Home run wiring from panelboard to first outlet box shall be installed in conduit. MC cable not permitted for fire alarm wiring systems or emergency lighting.
Wireways and Auxiliary Gutters	Where indicated on the drawings and as otherwise specifically approved.

3.2 RACEWAY SYSTEMS IN GENERAL

A. Provide raceways for all wiring systems unless noted otherwise. 277/480 volt wiring must be kept independent of 120/208 volt wiring. Where non-metallic raceways are utilized, provide sizes as required with the grounding conductor considered as an insulated additional conductor. Minimum size 3/4 inch for home runs and 1 inch minimum for power distribution. Wiring of each type and system must be installed in separate raceways.

B. Install capped bushings on raceways as soon as installed and remove only when wires are pulled. Securely tie embedded raceway in place prior to embedment. Raceways installed below or in floor slabs must extend a minimum of 4 inches above the finished slab to the first connector. Lay out the work in advance to avoid excessive concentrations or multiple raceway runs.

C. Locate raceways so that the strength of structural members is unaffected and they do not conflict with the services of other trades. Install 1 inch or larger raceways in or through structural members (beams, slabs, etc.) only when and in the manner accepted by the Professional. Draw up couplings and fittings full and tight. Protect threads from corrosion with one coat zinc chromate after installation.

D. Above Grade – Defined as the area above finished grade for a building exterior and above top surface of any slabs (or other concrete work) on grade for a building interior. Above-grade raceways to comply with the following:

1. Install raceways concealed except at surface cabinets and for motor and equipment connection in 0.4 and mechanical rooms. Install a minimum of 6 inches from flues, steam pipes, or other heated lines. Provide flashing and counter-flashing for waterproofing of raceways, outlets, fittings, etc., which penetrate the roof. Route raceways parallel or perpendicular to building lines with right-angle turns and symmetrical bends. Run embedded raceways in a direct line and, where possible, with long sweep bends and offsets. Provide sleeves in forms for new concrete walls, floor slabs and partitions for passage of raceways. Waterproof sleeved raceways where required.
2. Provide raceway expansion joints for exposed and concealed raceways with necessary bonding conductor at building expansion joints and between buildings or structures and where required to compensate for raceway or building thermal expansion and contraction.
3. Provide one empty 3/4 inch raceway for each three spare unused poles or spaces of each flush-mounted panelboard. Terminate empty 3/4 inch conduit in a junction box, which after completion, is accessible to facilitate future branch circuit extension.
4. Provide raceway installation (with appropriate seal-offs, explosion-proof fittings, etc.) in special occupancy area, as required. Provide conduit seal-offs where portions of an interior raceway system pass through walls, ceiling or floors which separate adjacent rooms having substantially different maintained temperatures, as in refrigeration or cold storage rooms.
5. Protect raceway in earth or fill with two coats of asphalt base paint. Touch up abrasions and wrench marks after conduit is in place.
6. In lieu of above, protect raceways with a minimum of 20 mil tape approved for the purpose and overlapped a minimum of 1/2 tape width.

7. Provide drag wire in spare or empty raceways. Tag both ends of wire denoting opposite and termination location with black India ink on flameproof linen tag.

E. Below Grade: Defined as the area below finished grade for a building exterior and below or within the bottom floor slab for a building interior. Below grade raceways to comply to the following.

1. Project below-grade raceways 2 inches minimum above floor or equipment foundation. Install exterior underground conduits 24 inches minimum below finished grade. Do not penetrate waterproof membranes unless proper seal is provided.

F. No raceway may be installed in a concrete slab except with the permission of the Structural Professional and with the written consent of the Client Agency. Conduits embedded in structural concrete slabs shall have the following minimum thickness and shall conform to the following:

Raceway Sizes	Minimum Thickness of Concrete Slab
3/4"	4 - 1/2"
1"	5"

1. Unless specifically approved in writing, raceways 1-1/4 inch size and larger shall not be installed in structural concrete slabs.
2. In no case will installation of raceways be permitted to interfere with the proper placement of principal reinforcement.
3. Raceways in structural slabs shall be placed between the upper and the lower layers of reinforcing steel. This will require careful bending of conduits.
4. Raceways embedded in concrete slabs shall be spaced not less than 8 inches on centers and as widely spaced as possible where they converge at panels or junction boxes.
5. Raceways running parallel to slab supports, such as beams, columns and structural walls, shall be installed not less than 12 inches from such supporting elements.
6. To prevent displacement during concrete pour of lift slab, saddle supports for conduit, outlet boxes, junction boxes, inserts, etc., shall be secured with suitable adhesives.

G. Rigid non-metallic conduit installations shall conform to the following:

1. All joints are to be made by the solvent cementing method using the material recommended by the raceway manufacturer. Fittings, cement and conduit shall be supplied by the same manufacturer.
2. Raceway cutoffs shall be square and made by handsaw or other approved means which does not deform the conduit. Raceway shall be reamed prior to solvent cementing to couplings, adapters, or fittings.
3. 0.4 devices which are served by PVC raceways to be grounded by means of ground wire pulled in the raceway.
4. Male box adapters shall be used for all box or raceway fittings to terminate plastic raceways.
5. Where separable terminations are required, they shall be made using PVC threaded adapters with locknuts or bushings. If such terminations must be watertight, "O" rings shall be installed.
6. Bends shall be made by methods that do not deform or damage the conduit. The radii of field bends shall not be less than those established by the NEC.
7. Raceway expansion fittings shall be provided in accordance with NEC. The position of the expansion fitting shall be adjusted proportional to the temperature at installation.
8. Raceway supports shall be installed in such a manner to allow the PVC conduit to slide through the supports as the temperature changes.
9. Elbows must be galvanized rigid steel.

10. Rigid non-metallic conduit is not permitted to be installed within the building.

H. Raceways in hung ceilings shall be run on and secured to slab or primary structural members of ceiling, not to lathing channels or T-bars or other elements which are the direct supports of the ceiling panels. Secure conduit firmly to steel by clips and fittings designed for that purpose. Install as high as possible, but not less than, 1-0" above hung ceilings.

I. Exposed raceways shall be run parallel or at right angles with building lines. Secure raceway clamps or supports to masonry materials by toggle bolts, expansion bolts, or steel inserts. Install raceway on steel construction with approved clamps which do not depend on friction or set-screw pressure alone.

J. Clear raceway of all obstructions and dirt prior to pulling in wires or cables. This shall be done with ball mandrel (diameter approximately 85% of conduit inside diameter) followed by close fitting wire brush and wad of felt or similar material. This assembly may be pulled in together with, but ahead of the cable being installed. All empty raceways shall be similarly cleaned. Clear any raceway which rejects ball mandrel.

K. Support less than 2 inch trade size, vertically run, raceways at intervals no greater than eight feet. Support such raceways, 2 inch trade size or larger, at intervals no greater than 10 feet.

L. Support less than 1 inch trade size horizontally run, raceways at intervals not greater than 7 feet. Support such raceways, 1 inch trade size or larger, at intervals no greater than 10 feet.

3.3 WIREWAY AND AUXILIARY GUTTER

A. Wireways installed in hung ceilings shall be placed such that the cover will hinge upward from the side.

B. A 12 inch clear work space shall be provided from wireway cover when it is in the open position.

3.4 OUTLET, JUNCTION, AND PULLBOXES

A. Provide outlet, junction, and pullboxes as indicated on the Drawings and as required for the complete installation of the various 0.4 systems, and to facilitate proper pulling of wires and cables. J-boxes and pullboxes shall be sized per NEC minimum.

B. The exact location of outlets and equipment is governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location of outlets, panels equipment, etc., with Professional.

C. Back-to-back outlets in the same wall or "thru-wall" type boxes are not permitted. Provide 12 inch (minimum) spacing for outlets shown on opposite sides of a common wall to minimize sound transmission.

END OF SECTION 26 0533

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. This Section includes the following:

1. Identification for 0.4 raceways
2. Identification of power and control cables
3. Identification for branch circuit and feeder conductors
4. Warning labels and signs per N.E.C.
5. Instruction signs
6. Identification labels for distribution equipment, junction boxes, cabinets and miscellaneous equipment.

1.4 SUBMITTALS

A. Product Data: Furnish type of material to be supplied for each 0.4 identification product indicated.

1.5 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Comply with ANSI A13.1
2. Comply with NFPA 70
3. Comply with 29 CFR 1910.144 and 29 CFR 1910.145
4. Comply with ANSI Z535.4 for safety signs and labels

1.6 COORDINATION

A. Coordinate identification names, abbreviations, colors and features with requirements in the Contract Documents, shop drawings, manufacturer's wiring diagrams and operation and manual and with those required by codes and standards.

PART 2 - PRODUCTS

2.1 POWER RACEWAY AND METAL CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Raceway Colors for Circuits at 600 V or Less

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.6 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 INSTALLATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 90A: Identify with orange self-adhesive vinyl label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands.

1. 0.2 and 0.4Supervisory System: Green and Blue
2. Telecommunication System: Green and Yellow
3. Control Wiring: Green and Red

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands 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.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power
2. Power

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

a. Colors for 208/120-V Circuits

1) Phase A: Black
2) Phase B: Red
3) Phase C: Blue
4) Neutral: White
5) Ground: Green

b. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

E. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install marking tape at flush-mounted panelboards and similar equipment in finished spaces.

F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

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

G. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of 0.4 systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions

    a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide five lines of text.

        1) First Line: 1/2-inch letters on the first line stating equipment name.
        2) Second Line (if applicable): 3/8-inch letters stating the existing equipment name in parentheses ( ).
        3) Third Line: 3/8-inch letters stating voltage/phase.
        4) Fourth Line: 3/8-inch letters stating the breaker number, panel name and room number/name (Client Agency's room number) from which the equipment is fed.
        5) Fifth Line: 3/8-inch letters stating function and/or equipment which it controls.

2. Equipment to be Labeled

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Switchboards.

END OF SECTION 26 0553

SECTION 26 0572 - SHORT CIRCUIT, COMPONENT PROTECTION, FLASH HAZARD AND SELECTIVE COORDINATION STUDY

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Provide a short-circuit, component protection, flash hazard analysis, and selective coordination study for the 0.4 distribution system from all power sources (normal and emergency) down to the branch circuit overcurrent protective device and equipment. The short circuit, selective coordination and flash hazard study shall be performed by the manufacturer supplying the equipment. Series rated systems are not approved.

1.3 PURPOSE

A. The study shall calculate the available short-circuit current at each point in the 0.4 distribution system. The overcurrent protective devices shall have an interrupting rating equal to or greater than the available short-circuit current at the point of application.

B. The study shall examine proper protection of 0.4 system components and utilization equipment such that the equipment has a sufficient short-circuit current rating. If a specific type of overcurrent protective device is required for proper protection of equipment, it shall be noted in the report and reflected in the design of the system.

C. The study shall include a flash hazard analysis for 0.4 distribution equipment. The analysis shall determine the flash protection boundary, incident energy, and required level of personal protective equipment (PPE) for workers at the 0.4 distribution equipment. The flash protection boundary and incident energy shall be determined based upon a working distance of 18 inches. The 0.4l distribution equipment shall be field marked with this information in accordance with codes and standards.

D. The overcurrent protective devices shall be analyzed for selective coordination. This analysis shall identify any potential selective coordination problems up to the available short-circuit current. Any areas where the overcurrent protective devices are not selectively coordinated shall be explicitly noted and recommendations shall be made to achieve selective coordination if desired.

E. The studies shall be submitted to the Design Professional, through eBuilder, prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Professional may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

F. The studies shall include all portions of the 0.4 distribution system from the normal power source or sources down to and including the smallest adjustable trip circuit breaker in the distribution system. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

G. The firm should be currently involved in high and low-voltage power system evaluation. The study shall be performed, stamped and signed by a registered Professional. Credentials of the individual performing the study and background of the firm shall be submitted to the Professional for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.

H. The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

1.4 REFERENCES

A. The study shall be completed in accordance with the latest edition of IEEE Standard 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

B. The flash hazard analysis shall be completed in accordance with latest editions of NFPA 70E – Standard for Electrical Safety Requirements for Employee Workplaces and IEEE Standard 1584 – Guide for Performing Arc-Flash Hazard Calculations.

1.5 DATA COLLECTION FOR THE STUDY

A. The Contractor shall provide the required data for preparation of the studies. The Professional performing the system studies shall furnish the Contractor with a listing of the required data immediately after award of the contract.

B. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacturing.

C. Short circuit calculations will need only to account for new equipment. Each 1500 kVA pad mounted substation transformer, based upon an infinite bus, will output 7,250 amps of symmetrical fault current at the secondary of the transformers. Available short circuit current at the output of the medium voltage transfer switch in the boiler plant will be less than this value.

1.6 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION AND COORDINATION STUDY

A. The short-circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.

B. In the short-circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, tabulations of calculation quantities and results, conclusions, and recommendations. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low-voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant overcurrent protective device locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor fault contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

C. In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

D. Include on the curve sheets power company relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. In addition, include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.

E. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical fault current to which the device is exposed.

F. Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristics curves from curves for other devices by at least a 0.4-second time margin.

G. Include complete fault calculations as specified herein based on contract documents.

H. Submit qualifications of individual(s) who will perform the work for approval prior to commencement of the studies. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Submit the study to Professional, through eBuilder, for review prior to delivery of the study to the Client Agency. Make all additions or changes as required by the Design Professional.

I. Contractor shall furnish all data as required by the short-circuit/coordination study vendor. Utilize data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.

J. Notify the Professional in writing of circuit protective devices not properly rated for fault conditions.

K. Mechanical Contractor to provide settings for the packaged chiller and/or motor starters.

L. When emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Contractor shall obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

1.7 SUBMITTALS

A. The results of the study shall be summarized in report form. Submit 6 copies for review and approval by the design Professional.

B. The results of the study shall include the following:

1. Descriptions, purpose, basis, and scope of study.
2. Fault current calculations including definition of terms and guide for interpretation of computer printout.
3. Tabulations of protective device and equipment ratings versus calculated short-circuit duties, and commentary regarding same.
4. Flash hazard analysis report for 0.4 distribution equipment.
5. Time versus current curves or fuse selectivity ratio analysis, with tabulations of overcurrent protective device settings, and selective coordination analysis and commentary regarding same.

C. If power company review and approval is required, the results of the study shall be submitted to the power company for review and approval. Approved copies from the power company shall be forwarded to the design Professional.

1.8 SUBMITTALS – CLOSEOUT

A. Submit 1 copy of the final approved study to eBuilder.

PART 2 - PRODUCTS

2.1 REQUIREMENTS

A. The short circuit and flash hazard analysis study shall be completed with the aid of a computer software program where possible.

B. The available short-circuit current, corresponding required interrupting or short-circuit current ratings of components, and flash hazard analysis data, shall be calculated based upon the 3-phase bolted short-circuit, current and phase to ground/neutral short-circuit current at each of the following (if applicable):

1. Utility Service Point.
2. Medium voltage switchgear.
3. Medium voltage motor controllers.
4. Medium/Low-Voltage Unit Substations.
5. Low-voltage switchgear or switchboards.
6. Distribution panelboards.
7. Branch circuit panelboards.
8. Motor control centers.
9. Busway and Busplugs.
10. Other significant equipment or utilization equipment.

C. The study shall include the following:

1. Calculation methods and assumptions.
2. One-line diagram (with available short-circuit current and flash hazard data identified).
3. Calculations shall identify:

a. Available short-circuit currents from all power sources (kVA).

b. Motor fault contribution.
c. Component impedance data.
d. X to R ratio.
e. Symmetrical and asymmetrical fault current characteristics.
f. Flash hazard analysis data.

4. Tabulation of all calculation quantities and results.
5. Detailed description of each protective device identifying its type, function, manufacturer, interrupting rating, ampere rating, selected settings, and time-current characteristics.
6. System component characteristic curves or short-circuit current ratings identified and/or plotted up to the maximum symmetrical fault current to which the component is exposed. Include the following where applicable:

   a. Medium voltage equipment characteristics.
   b. Low voltage equipment characteristics.
   c. ICEA conductor damage characteristics.
   d. Transformer characteristics.
   e. Motor and motor circuit equipment characteristics.
   f. Generator and transfer switch (manual or automatic) characteristics.
   g. Other system equipment characteristics.

7. Time-current curves prepared graphically on full size, log-log forms with title, one-line diagram, and specific system components analyzed.
8. Conclusions regarding interrupting rating for overcurrent protective devices, flash hazard analysis, protection of components, selective coordination, and recommendations and requirements on the same.

2.2 LABELS

A. Arc flash and shock hazard labels shall be provided and installed on all equipment in the report noting the appropriate PPE required. Submit sample label for approval. A sample label format is available from the Professional.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study, and protective device coordination study.

B. Necessary field settings of devices, adjustments, and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Client Agency.

END OF SECTION 26 0572

SECTION 26 1219 – MEDIUM VOLTAGE PAD-MOUNTED TRANSFORMER – LIQUID FILLED

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SCOPE

A. This This specification covers the electrical and mechanical characteristics of series 45-10,000 kVA Three-Phase Step-Down Pad-Mounted Distribution Transformers. KVA ratings for transformers with secondary voltages not exceeding 700V are 45-5000 kVA, while kVA ratings for transformers with secondary voltages greater than 700V are 500-12,000 kVA. Product is per Catalog Data CA202003EN.

1.3 APPLICABLE STANDARDS

A. All characteristics, definitions, and terminology, except as specifically covered in this specification, shall be in accordance with the latest revision of the following IEEE®, Department of Energy, and NEMA® standards.

1. IEEE Std C57.12.00™-2015 – IEEE Standard for Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. IEEE Std C57.12.28™-2014 – Sections 5.3, 5.4, 5.5 – Coating System Requirements
3. IEEE Std C57.12.36™- 2017 – IEEE Standard Requirements for Liquid-Immersed Distribution Substation Transformers
4. IEEE Std C57.12.70™-2011 – IEEE Standard for Terminal Markings and Connections for Distribution and Power Transformers
5. IEEE Std C57.12.90™-2010 – IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and IEEE Guide for Short-Circuit Testing of Distribution and Power Transformers
6. IEEE Std C57.154™ -2012 – IEEE Standard for the Design, Testing, and Application of Liquid-Immersed Distribution, Power, and Regulating Transformers Using High-Temperature Insulation Systems and Operating at Elevated Temperatures
7. NEMA® TR 1-1993 (R2000) – Transformers, Regulators and Reactors, Table 0-2 Audible Sound Levels
8. 10 CFR Part 431 – Department of Energy–Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule
9. IEEE Std 386™-2006 – IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Eaton

B. Square D

C. General Electric

2.2 RATINGS

A. The transformer shall be designed in accordance with this specification and the base kVA rating shall be: 500 kVA

B. The transformer shall have a high voltage and the basic lightning impulse insulation level (BIL) of 2,400 V and 60 kV BIL

C. The low voltage and the basic lightning impulse insulation level (BIL) shall be 208Y/120 V and 30 kV BIL.

D. The transformer may be furnished with full capacity high-voltage taps. The tap changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap changer as required in Section 4.3 of IEEE Std C57.12.34™-2015 standard. The unit shall have one of the following tap configurations:

1. No Taps

E. The average winding temperature rise above ambient temperature, when tested at the transformer rating, shall be 65°C average winding temperature rise rating. The above winding temperature rise shall not exceed 65°C when loaded at base kVA rating.

F. The percent impedance voltage, as measured on the rated voltage connection, shall be per 1.7 – 5.75%. For target impedances, the tolerance on the impedance shall be +/- 7.5% of nominal value for impedance values greater than 2.5%. The tolerance on the impedance shall be +/- 10.0% for impedance values less than or equal to 2.5%.

2.3 CONSTRUCTION

A. The core and coil shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the windings will be energized to heat the coils and drive out moisture, and the transformer will be filled with preheated filtered degassed insulating fluid. The core shall be manufactured from burr-free, grain-oriented silicon steel and shall be precisely stacked to eliminate gaps in the corner joints. The coil shall be insulated with B-stage, epoxy coated, diamond pattern, insulating paper, which shall be thermally cured under pressure to ensure proper bonding of conductor and paper. Coils shall be copper.

B. The dielectric coolant shall be listed less-flammable fluid meeting the requirements of National Electrical Code Section 450-23 and the requirements of the National Electrical Safety Code (IEEE Std C2™-2002 standard), Section 15. The dielectric coolant shall be non-toxic*, non-bioaccumulating and be readily and completely biodegradable per EPA OPPTS 835.3100. The base fluid shall be 100% derived from edible seed oils and food grade performance enhancing additives. The fluid shall not require genetically altered seeds for its base oil. The fluid shall result in zero mortality when tested on trout fry *. The fluid shall be certified to comply with the US EPA Environmental Technology Verification (ETV) requirements and tested for compatibility with transformer components. The fluid shall be Factory Mutual Approved®, UL® Classified Dielectric Medium (UL-EOUV) and UL® Classified Transformer Fluid (UL-EOVK), Envirotemp™ FR3™ fluid. *(Per OECD G.L. 203)

C. Tank and Cabinet Enclosure

1. The high-voltage and low-voltage compartments, separated by a metal barrier, shall be located side-by-side on one side of the transformer tank. When viewed from the front, the low-voltage compartment shall be on the right. Each compartment shall have a door that is constructed so as to provide access to the high-voltage compartment only after the door to the low-voltage compartment has been opened. There shall be one or more additional fastening devices that must be removed before the high-voltage door can be opened.

Where the low-voltage compartment door is of a flat panel design, the compartment door shall have three-point latching with a handle provided for a locking device. Hinge pins and associated barrels shall be constructed of corrosion-resistant material, passivated ANSI® Type 304 or the equivalent.

2. A recessed, captive, penta-head or hex-head bolt that meets the dimensions per IEEE Std C57.12.28™-2014 standard shall secure all access doors.
3. The compartment depth shall be in accordance with IEEE Std C57.12.34™-2009 standard, unless additional depth is specified.
4. The tank base must be designed to allow skidding or rolling in any direction. Lifting provisions shall consist of four lifting lugs welded to the tank.
5. The tank shall be constructed to withstand 7 psi without permanent deformation, and 15 psi without rupture. The tank shall include a 15 psig pressure relief valve with a flow rate of minimum 35 SCFM.
6. The exterior of the unit shall be painted Munsell 7GY3.29/1.5 green (STD), ANSI® 70 gray, or ANSI® 61 gray in color. If a special paint color is specified, a federal spec number or paint chip must be provided at the time of order. The cabinet interior and front plate shall be painted gray for ease of viewing the inside compartment.
7. The tank shall be complete with an anodized aluminum laser engraved nameplate. This nameplate shall meet Nameplate B per IEEE Std C57.12.00™-2015 standard.

D. High Voltage Bushings and Terminals

1. High voltage bushings will be installed in the high voltage termination compartment located on the front left of the transformer and requiring access via the low voltage termination compartment on the front right.
2. Bushing Style

    a. 15/25 KV DEADFRONT, CURRENTS BELOW 200 AMPS: The high voltage bushings shall be 15/25 kV 200A bushing wells with bushing well inserts installed. The bushings shall be externally removable and be supplied with a removable stud (Re: Catalog Data CA800016EN, 500-12, and 500-26).

3. Bushing Configuration

    a. 15/25 KV RADIAL FEED DEADFRONT: The transformer shall be provided with three (3) high voltage bushings in accordance with Figure 1 dimensions from IEEE Std C57.12.34™-2015 standard for radial feed configurations. The bushing heights shall be in accordance with Figure 3 dimensions of IEEE Std C57.12.34™-2015 standard.

E. Low Voltage Bushings and Terminals

1. Bushing Style

    a. Voltages less than 700 Volts: The transformer shall be provided with tin-plated spade-type bushings for vertical takeoff. The spacing of the connection holes shall be 1.75” on center, per IEEE Std C57.12.34™-2015 standard Figure 19. The quantity of connection holes shall be 4, 6, 8, 12, 16, or 20 holes.
    b. Transformers 300 kVA and below, and 500 kVA with 480Y/277 secondary will have two-piece low voltage bushings with studs and screw on spades. Transformers 500 kVA with 208Y/120 secondary and all transformers above 500 kVA will have one-piece bushings.
    c. Bushing supports shall be provided for transformers requiring 10 or more connection holes. Bushing supports shall be affixed to the cabinet sidewalls; tank-mounted supports mountings are not acceptable.

2. Bushing Configuration

a. The transformer shall be provided with bushings in a staggered arrangement in accordance with Figure 11a dimensions of IEEE Std C57.12.34™-2015 standard.
b. Voltages greater than 700 Volts: Secondary arrangements shall be live-front or dead-front. Dead-front application with a required neutral shall have a porcelain X0 bushing. Dead-front application may be loop feed when specified. Provide additional front barrier for high voltage live front secondary, creating an additional barrier after the low voltage door has been opened. Dead front bushings are limited to below 900amps.

F. Labeling

1. A temporary bar code label shall be attached to the exterior of the transformer in accordance with IEEE Std C57.12.34™-2009 standard.

G. Finish Performance Requirements

1. The tank coating shall meet all requirements in IEEE Std C57.12.28™-2014 standard including:

a. Salt Spray
b. Crosshatch adhesion
c. Humidity
d. Impact
e. Oil resistance
f. Ultraviolet accelerated weathering
g. Abrasion resistance – taber abraser

2. The enclosure integrity of the tank and cabinet shall meet the requirements for tamper resistance set forth in IEEE Std C57.12.28™-2014 standard including but not limited to the pry test, pull test, and wire probe test.

H. Optional features to reduce exposure to arc flash

1. Additional transformer rating nameplate – In addition to the standard nameplate located on the transformer tank, a second nameplate shall be included. The nameplate shall be mounted external to the termination compartments with an industrial grade double-sided adhesive. Its location shall be identified on the data sheet.

I. The following standard accessories and options shall be provided:

1. 1.0” Upper Fill Plug with Filter Press Connection
2. 1.0” Drain/Sampling Valve
3. Bolted Cover
4. Lifting Lugs (4)
5. Liquid Level Gauge
6. Dial Type Thermometer
7. Pressure/Vacuum Gauge

J. Accessories

1. Danger high voltage warning signs

PART 3 – EXECUTION

3.1 PRODUCTION TESTING

A. All units shall be tested for the following:

1. No-Load (85 °C or 20 °C) losses at rated current
2. Total (85 °C) losses at rated current
3. Percent Impedance (85 °C) at rated current
4. Excitation current (100% voltage) test
5. Winding resistance measurement tests
6. Ratio tests using all tap settings
7. Polarity and phase relation tests
8. Induced potential tests
9. Full wave and reduced wave impulse test

B. Transformers shall conform to efficiency levels for liquid immersed distribution transformers, as specified in the Department of Energy ruling “10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule; April 18, 2013.” Manufacturer shall comply with the intent of all regulations set forth in noted ruling.

C. In addition, the manufacturer shall provide certification upon request for all design and other tests listed in IEEE Std C57.12.00™-2010 standard, including verification that the design has passed short circuit criteria per IEEE Std C57.12.00™-2010 standard and IEEE Std C57.12.90™-2010 standard.

D. In the event of proposal bid evaluated with guaranteed losses due to a loss evaluation (see section 10.0), manufacturer shall conform to guaranteed average losses as specified in IEEE Std C57.12.00™-2010 standard. The no-load losses of a transformer shall not exceed the specified no-load losses by more than 10%, and the total losses of a transformer shall not exceed the specified total losses by more than 6%.

3.2 SHIPPING

A. Transformers, 1000 kVA and below, shall be palletized. Transformers, 1500 kVA and larger, shall be loaded and unloaded with overhead cranes, so a pallet is not to be provided for these transformers.

3.3 SUBMITTALS

A. The following data shall be submitted, through eBuilder:

1. Core losses
2. Winding losses
3. Percent Impedance
4. Drawings – drawings shall show final dimensions and features.

3.4 SERVICE

A. The manufacturer of the transformer shall have regional service centers located within two (2) hours flight time of all contiguous 48 states. Service personnel shall be factory trained in commissioning and routine service of quoted transformers.

END OF SECTION 26 1213

SECTION 26 2413 - SWITCHBOARDS – LOW VOLTAGE

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SCOPE

A. The Contractor shall furnish and install, where indicated, a free-standing, dead-front type low voltage distribution switchboard, utilizing group mounted circuit protective devices as specified herein, and as shown on the contract drawings.

1.3 RELATED SECTIONS

A. Specification Section 26 28 11 – Circuit Breakers – Low Voltage.

B. Specification Section 26 27 13 – Microprocessor- Based Metering Equipment.

C. Specification Section 26 43 13 – Surge Protection Devices for Low Voltage Electrical Circuits.

1.4 REFERENCES

A. The low voltage distribution switchboards and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:

1. UL Standard 891 – Switchboards
2. UL Standard 50 – Enclosures for Electrical Equipment
3. NEMA PB-2 Switchboards
4. UL Standard 489 – Circuit Breakers
5. UL Standard 1449 – Surge Protective Devices
6. UL Standard 508 – Industrial Control Equipment

1.5 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted through eBuilder:
1. Front view and plan view of the assembly
2. Floor plan
3. Top Floor
4. Single Line Diagrams
5. Schematic diagram
6. Nameplate schedule
7. Component list
8. Conduit space locations within assembly
9. Assembly ratings including:

a. Short-circuit rating
b. Voltage
c. Continuous current rating

10. Major component ratings including:

a. Voltage
b. Continuous current rating
c. Interrupting ratings

11. Cable terminal sizes
12. Product data sheet

B. Where applicable, the following additional information shall be submitted to the Design Professional:

1. Busway connection.
2. Connection details, composite front view, and plan view of close-coupled assemblies.
3. Key interlock scheme drawing and sequence of operations.
4. Automatic transfer scheme sequence of operation.
5. Mimic bus size and color.

1.6 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for, through eBuilder, record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process.
2. Wiring diagrams
3. Certified production test reports
4. Installation information
5. Seismic certification with equipment anchorage details and center of gravity as specified
6. Coordination Drawings if required: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

a. Required working clearances and required area above and around Switchboard.
b. Show Switchboard layout and relationships between electrical components and adjacent structural and mechanical elements.

1.7 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The Switchboard manufacturer shall have the Environment Certification ISO 14001.

D. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty (20) years. When requested by the Design Professional, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

E. Where noted in the contract documents provide seismic qualified equipment.

1.8 REGULATORY REQUIREMENTS

A. The low-voltage switchboard shall be UL labeled.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Eaton

1. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Design Professional ten (10) days prior to bid date.
2. The switchboard shall be equal to Eaton type Pow-R-Line Xpert utilizing the components herein specified and as shown on the drawings.

B. Square D

C. ABB

D. Siemens

2.2 RATINGS

A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage or as shown on the contract documents.

B. Bus voltage and current rating to be as indicated on the contract documents.

2.3 CONSTRUCTION

A. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.

B. All sections of the switchboard shall be front and rear aligned with depth(s) shown on the drawings.

C. The assembly shall be provided with adequate lifting means.

D. The switchboard shall be suitable for use as service entrance equipment where indicated on Contract Documents and be labeled in accordance with UL requirements.

2.4 BUS

A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria.

B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.

C. A 1/4 x 2-inch copper ground bus (minimum) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

E. All bussing shall be fully-rated for the entire length of the switchboard lineup. Tapered bus is not acceptable.

2.5 WIRING/TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

B. Mechanical-type terminals shall be provided for all line and load terminations. Terminals shall be suitable for copper or aluminum conductors rated per 75 degrees C for the size as shown on the drawings. 90 degrees C conductor is permissible but must be sized in accordance with 75 degrees C rated conductor tables.

C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.6 MAIN AND TIE PROTECTIVE DEVICES

A. Molded case main and tie protective devices

1. Molded case main and tie protective devices shall be fixed mounted molded case circuit breakers, Power Defense Frame 6 up to 2000A or approved equal.
2. All main and tie breakers shall be UL listed for continuous application in their intended enclosures for 100% of their continuous ampere rating.
3. All main and tie circuit breakers shall have a minimum symmetrical interrupting capacity of 65,000 amperes. Main and tie circuit breakers shall have 3 cycle short-time withstand ratings.
4. All main and tie molded case circuit breakers shall be UL489 listed.
5. All molded case circuit breakers shall have a nameplate clearly marking any electrical accessories that are mounted in the breaker at the time of sale. The accessory shall have a label that will indicate its function and voltage. All accessories shall be modular, plug and lock type, and UL listed for easy field installation.
6. Each molded case circuit breaker shall be equipped with a true RMS sensing, solid-state tripping system consisting of at least three current sensors microprocessor-based trip

device and trip actuator. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection.

7. Provide trip units with integral arc flash reduction mode (ARMS) for 1200A frame and above to meet NEC Article 240.87. The use of ZSI to satisfy NEC 240.87 does not meet the intent of these specifications and will not be acceptable as a substitution.
8. Where noted on the contract documents provide zone selective interlocking between trip units.
9. System coordination shall be provided by adjusting rotary switches for the following microprocessor-based time-current curve shaping adjustments:

    a. Adjustable long-delay pick-up setting with minimum of 10 settings.
    b. Adjustable long-delay time - 0.5 to 24 seconds.
    c. Adjustable short-delay pick-up setting – 1.5x to Max allowable by frame.
    d. Adjustable short-delay time 0.0 sec up to 0.5 sec depending on frame with selectable flat or I2t curve shaping.
    e. Adjustable instantaneous setting 2x to Max allowable by frame.
    f. Where indicated, adjustable ground fault current pickup (0.2 – 1.0 x In in 0.10x increments) and time (0.1 – 1.0 sec in 0.10sec increments), with selectable flat or I^2t curve shaping. Provide switch selectable options for GF OFF, GF alarm, or GF trip.

10. Where indicated provide 100% rated UL listed circuit breakers.
11. Trip units shall be capable of metering phase, neutral, and ground current with an accuracy of +/- 2.0% of the reading.

2.7 FEEDER PROTECTIVE DEVICES

A. All feeder protective devices shall be Eaton type Power Defense or approved equal molded case circuit breakers with inverse time tripping characteristics.

B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the contract documents.

D. Circuit breakers to be either draw-out or fixed mounted, as indicated on Contract Documents.

E. Where shown on the drawings, circuit breakers shall have microprocessor-based rms sensing trip units as specified below:

1. All molded case circuit breakers shall be equipped with a true RMS sensing, solid-state tripping system consisting of at least three current sensors microprocessor-based trip device and trip actuator. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection.
2. Provide trip units with integral arc flash reduction mode for 1200A frame and above. The use of zone selective interlocking to emulate this feature does not meet the intent of these specifications and will not be allowed.
3. System coordination shall be provided by adjusting rotary switches for the following microprocessor-based time-current curve shaping adjustments:

    a. Adjustable long-delay pick-up setting with minimum of 10 settings.
    b. Adjustable long-delay time - 0.5 to 24 seconds

c. Adjustable short-delay pick-up setting – 1.5x to Max allowable by frame
d. Adjustable short-delay time 0.0 sec up to 0.5 sec depending on frame with selectable flat or I2t curve shaping.
e. Adjustable instantaneous setting 2x to Max allowable by frame.
f. Where indicated, adjustable ground fault current pickup (0.2 – 1.0 x In in 0.10x increments) and time (0.1 – 1.0 sec in 0.10sec increments), with selectable flat or I^2t curve shaping. Provide switch selectable options for GF OFF, GF alarm, or GF trip.

4. Where indicated provide 100% rated UL listed circuit breakers.
5. Trip units shall be capable of metering phase, neutral, and ground current with an accuracy of +/- 2.0% of the reading.

2.8 ACCESSORIES

A. Provide shunt trips, bell alarms and auxiliary switches as shown on the contract drawings.

2.9 MISCELLANEOUS DEVICES

A. Key interlocks shall be provided as indicated on the drawings.

B. Control power transformers with primary and secondary protection shall be provided, as indicated on the drawings, or as required for proper operation of the equipment.

C. For outdoor (NEMA 3R) installations, each section of the switchboard shall be provided with a thermostatically controlled space heater· Power for the space heaters shall be obtained from a source as indicated on the drawings.

2.10 UTILITY METERING

A. Where indicated on the drawings, furnish a barrier to separate the utility metering compartment complete with hinged sealable door. Bus work shall include provisions for mounting utility company current transformers and potential transformers, or potential taps as required by the utility company.

B. Provide service entrance label and provide necessary applicable service entrance features per NEC and local code requirements.

2.11 SURGE PROTECTIVE DEVICE

A. SPD shall comply with ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL).

B. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

C. The SPD shall be of the same manufacturer as the switchboard.

D. The SPD shall be factory installed integral to the switchboard by the original equipment manufacturer.

E. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

F. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located within immediate proximity to the SPD.

G. All monitoring and diagnostic features shall be visible from the front of the equipment.

H. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

I. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

J. Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

K. Type 2 units with filtering shall conform to UL 1283 5th Edition.

L. Type 1 units shall not contain filtering or have a UL 1283 5th Edition Listing.

M. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

N. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

1. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
2. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
3. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes
4. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
5. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
6. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

O. Electrical Requirements:

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.
4. Unit shall operate without the need for an external overcurrent protection device (OCPD) and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.
5. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

6. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
7. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

2.12 ENCLOSURES

A. NEMA 1 Enclosure

2.13 NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.14 FINISH

A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

PART 3 – EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to ensure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

C. Factory to connect and setup ethernet gateways and/or data aggregation processors (such as Eaton PXG900 or Power Xpert Dashboard Lite) included in switchboard assemblies. Factory testing should also include confirmation that the processor and display communicate with each other and that every device connected to the processor is communicating with the processor. Addresses for the communicating devices in these networks will be indicated on factory supplied communication drawings.

3.2 MANUFACTURER'S CERTIFICATION

A. A certified test report of all standard production tests shall be available to the Design Professional upon request.

3.3 TRAINING

A. The Contractor shall provide a training session for up to five (5) Client Agency representatives for 2 normal workdays at a job site location determined by the Client Agency.

B. A manufacturer's qualified representative shall conduct the training session. The training program shall consist of instruction on operation of the assembly, circuit breakers, fused switches, and major components within the assembly.

3.4 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code.

B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills provided the floor is level to 1/8 inch per 3-foot distance in any direction. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

3.5 FIELD ADJUSTMENTS

A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.

B. Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Client Agency.

END OF SECTION 26 2413

SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. General: Provide panelboards in accordance with the Contract Documents.

1.3 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Panelboards

a. UL Standards #67.
b. UL Standard 50 Cabinet and Boxes
c. Federal Standard W-P-115.
d. NEMA Standard PB-1
e. Circuit Breakers – Type 1, Class 1.

1.4 SUBMITTALS

A. Submittals will be furnished. Submittals failing to meet the following criteria will be returned without a review or acceptance.

B. With each panelboard drawing the following is required:

1. Show main devices and lug sizes; branch circuit device sizes and arrangement; bus ampacities; withstandability and short circuit rating; dimensions and construction; gutter and backbox dimensions; nameplate and legend; protective coating; and all pertinent details of panel, enclosure, cover, and method of securing cover and lock.

1.5 QUALITY ASSURANCE

A. Each panelboard as a complete and finished product shall receive a single integrated equipment rating by the manufacturer. The integrated equipment short circuit wiring shall certify that all equipment is capable of withstanding the thermal and magnetic stress of a fault equal to the value specified on the Drawings. Such rating shall be established by actual tests by the manufacturer on similar equipment. This certification shall be permanently affixed to each panelboard. Test data shall be submitted to the Professional at time of submission of Acceptance Drawings.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Eaton

B. Square D

C. General Electric

D. Siemens

E. 120/208 volts circuit breaker type panelboards are to be equal to Eaton Pow-R Line 1.

F. Breaker distribution panelboards are to be equal to Eaton Pow-R-Line-4B.

2.2 PANELBOARDS IN GENERAL

A. Provide panelboards consisting of an assembly of branch circuit switching and protective devices (circuit breakers, switch and fuse units, or combination thereof) mounted inside a dead front enclosure. Provide the number and size of these branch circuit devices as indicated by the circuiting, on the drawings, and in the schedules.

B. Provide the following modifications and additional equipment as shown on the Drawings:

1. Main circuit breakers.
2. Feed through lugs and/or bus.
3. Feed through cabling arrangements.
4. Ground fault interrupting circuit breakers.

C. Interiors

1. Rigid removable assembly of copper bus bars and interchangeable bolted branch circuit devices.
2. Bus bars drilled to permit branch circuit devices of all sizes and number of poles to be interchangeable and installed in any spare space of sufficient size, without disturbing adjacent units; without removing main bus or branch circuit connectors and without machining, drilling, or tapping in the field.
3. Arrange bus in sequence or distributed phasing so that multipole circuit breaker can replace any group of single circuit breakers of the same size.
4. Provide copper neutral bus in each panelboard.
5. Provide copper ground bus in each panelboard.

D. Enclosure

1. Code gauge steel box galvanized.
2. Provide a bolt-on ground connector to inside of enclosure.
3. Flush mounted in finished areas and where indicated. Surface mount elsewhere.

E. Front

1. Doors must be provided on all lighting and power distribution panels. On switch and fuse panelboards, doors for overcurrent devices are not to be provided.
2. Heavy code gauge steel as required to maintain panel face flat.
3. Hold front closed with trim clamps.
4. Factory finished in medium gray enamel or two coats of air-drying lacquer over a rust inhibitor.
5. Provide directory for total number of poles.
6. Provide approved lock. All panels keyed alike. Furnish 4 sets of matching keys to the Client Agency.
7. Welded angle rest at the bottom of the door to facilitate cover installation.

8. Doors over 48" in height shall have auxiliary fasteners at top and bottom of door in addition to lock and catch.
9. Door-in-door construction.

F. Terminal lugs

1. Bolted type, labeled for either copper or aluminum conductors.
2. Locate main lugs properly at top or bottom, depending where main feeder enters.

G. Electrical Ratings

1. Panelboards are to be rated 120/208 3 phase, 4 wire, full neutral with ampacities as indicated on the Drawings (unless otherwise noted).
2. Short circuit withstand ratings shall be as indicated on the Drawings. Panelboards shall be fully rated. Series rated not acceptable.
3. Where indicated, provide panelboards having a "service entrance" Type UL label with neutrals factory bonded to frame or enclosure.

H. Circuit Breaker Devices

1. Plastic molded case. Completely sealed enclosure. Toggle type operating handle. Trip ampere rating and ON/OFF indication clearly visible.
2. Thermal-magnetic trip-free, trip-indicating, quick-make, quick-break, with inverse time delay characteristics. Single-handle and common tripping multipole breakers.
3. Silver alloy contacts with auxiliary arc-quenching devices.
4. Panelboard must be of the type which will accept the field installation of shunt trip devices of 60 amperes or less on the branch devices.
5. Interrupting capacities shall be as indicated on the Drawings. In general, 120/208 volt devices shall be not less than (10,000 AIC).
6. Bolted type terminals UL listed for either aluminum or copper 75 degrees C cables.
7. Provide main breakers in panels served from transformers.
8. Locate next to each breaker or space unit an individual number.
9. Panelboard shall accept circuit breakers from 15 ampere to 100 ampere.

I. Ground Fault Interrupters

1. Ground fault interrupter branch circuit breakers shall be as indicated in panel schedules. Circuit breakers shall be circuit interrupting which will operate manually for normal switching functions and automatically under overload, short circuit, and 0.005 amp line-to-ground fault conditions. The operation mechanism shall be entirely trip-free so that contact cannot be held closed against an abnormal overcurrent, short circuit, or ground fault condition. The device shall be bolt-on type with insulated case construction and shall be interchangeable with standard 1 P breakers utilized in the panelboard.

2.3 DISTRIBUTION PANELBOARDS

A. Distribution panelboards with bolt-on devices shall have interrupting ratings as specified herein or indicated on the drawings. Panelboards shall be fully rated. Panelboards shall be Eaton type Pow-R-Line 4B.

B. Where indicated, provide circuit breakers UL listed for application at 80% of their continuous ampere rating in their intended enclosure.

C. Trip Units for Molded Case Circuit Breakers – 1200 A and Below

1. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tipping characteristics and shall be Eaton or approved equal.
2. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
3. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.
4. Circuit breakers 225-ampere frame and below shall have thermal-magnetic trip units and inverse time-current characteristics.
5. Circuit breakers 250-ampere through 1200-ampere frame shall have microprocessor-based rms sensing trip units.
6. Ground fault protection shall be provided where indicated.

D. Enclosure

1. Enclosures shall be at lest 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.
2. Enclosures shall be provided with blank ends.

E. Nameplates

1. Provide an engraved nameplate for each panel section.

2.4 SURGE PROTECTIVE DEVICES

A. Provide surge protective devices as specified in Section 264313.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount panel 4 feet to panel center but with maximum height of 6 feet 6 inches to handle of topmost switching device.

B. Mount surface type panels a minimum of 1 inch off wall on channels.

C. Connect feed-through panels to main feeder by insulated parallel gutter taps. Full-size tap for two panels on a common feeder. Increase cabinet width to accommodate gutter tap.

D. Where flush mounted, the fire integrity of the wall in which it is installed must be maintained.

E. Neatly arrange branch circuit wires and tie together in each gutter with Thomas & Betts nylon "Ty-Raps", or approved equal at minimum 4 inch intervals.

F. Plug all knockouts removed and not utilized.

3.2 TOUCH UP AND CLEANING

A. Vacuum all backboxes clean of debris after installation and prior to final payment.

B. Touch up scratch marks, etc. with matching paint.

END OF SECTION 26 2416

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTIONS

A. General: Provide wiring devices in accordance with the Contract Documents.

1.3 QUALITY ASSURANCE

A. Switches and receptacles shall be of the same manufacturer.

B. Reference shall be made to the drawings for additional wiring devices not noted in this section of the specifications.

C. Manufacturer shall have a minimum of ten (10) years experience in the manufacture of wiring devices similar to those specified on this project.

D. Manufacturer shall have ISO-9002 certification.

1.4 STANDARDS

A. Switches: Federal Specifications WS-896E, NEMA WD-1, and UL 20.

B. Receptacles: Federal Specification W-C-596, NEMA WD-1, NEMA WD-6, and UL 498.

C. Ground Fault Circuit Interrupter Receptacles: UL 943 Class A.

1.5 SUBMITTALS

A. Product Data: For each type of products.

B. Shop Drawings: List and description of materials and the method for receptacle identification.

1.6 COLORS

A. Device and coverplate (stamped steel) colors connected to the normal power system shall match existing finish.

B. Switches and receptacles connected to the emergency power system shall be red.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Catalog numbers shall not be used to determine colors of devices and coverplates. Catalog numbers are used to establish minimum acceptable standard.

B. Switches and Receptacles: Hubbell or equal, by Cooper Wiring Devices, Leviton, and Pass & Seymour.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, 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 NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.
3. Receive Client Agency approval.

D. Devices for Client Agency-Furnished Equipment:

1. Receptacles: Match plug configurations.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.3 SWITCHES

A. General

1. Switches shall be of the type indicated on the Drawings.
2. Switches shall be commercial specification grade, quiet type, 20A, 120/277V, 1 HP rated at 120V, back and side wired, silent handle operation.

B. Single-Pole, Double Throw, Momentary Contact Switches

1. Toggle handle type, center off: Hubbell: HBL1557.

2.4 RECEPTACLES

A. General

1. Receptacles shall be of the type indicated on the Drawings.
2. Receptacles shall be heavy duty 20A specification grade, 125V, grounding type, back and side wired.

B. Receptacles

1. Duplex, 20A: Hubbell: HBL5362.

C. Ground Fault Circuit Interrupter Receptacles

1. Duplex, 20A: Hubbell: HBLGF20LA.

D. Special purpose receptacles: Rating as indicated on the Drawings.

E. Weatherproof Receptacles and Cover

1. Exterior weatherproof outlet shall be Hubbell. While in use, cast aluminum, 1 gang vertical, GFCI receptacle Catalog #WP26M or approved equal.

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Stamped Steel.
3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations".

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. The exact location of wiring devices shall be determined by location of equipment and as detailed on the Architectural Drawings. Prior to installation the Client Agency has the right to have the devices relocated 25'-0" at no cost.
2. Devices mounted above counters shall be 2 inches above the top of the backsplash to the bottom of the coverplate.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 26 2726

SECTION 26 2813 - FUSES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. General: Provide fuses in accordance with the Contract Documents.

1.3 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. UL Standard #198

1.4 SUBMITTALS

A. Provide a complete set of shop drawings to include let-thru curves for each type of fuse, a schedule of spare fuse cabinets with a listing of fuses provided within each spare fuse cabinet, and dimensioned drawings of each spare fuse cabinet by type and size.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mains, Feeders and Branch Circuits

1. General

a. All fuses shall be labeled as UL Class L or UL Class R, current limiting and rated for up to 200,000 amperes. Time delay Class R fuses shall be so labeled.

2. Main Service and all Feeder Circuits

a. Fuses over 600 amperes shall be UL Class L. Fuses up to 600 amperes shall be UL Class RK1. If fuses directly feed motors or transformers, they shall be UL RK1, labeled Time-delay.

3. Branch Circuits

a. Feeding circuit breaker panels shall be UL Class RK1.
b. Feeding motor circuits shall be UL Class RK1 labeled as Time-delay.

4. All fuses shall be so selected as to provide a selectivity coordinated system.
5. All fuses shall be of the same manufacturer.
6. All fuses to be of the Class R type.

B. Spares: Upon completion of the building, the contractor shall provide the Client Agency with spare fuses as indicated below:

1. 10 percent (minimum of 3) of each type and rating of installed fuses shall be supplied as spares.
2. Spare fuse cabinets shall be provided to store the above spares.
3. Spare fuse cabinets shall be provided as a minimum in the following locations:

a. Each main switchgear room.
b. Each major mechanical equipment room.

C. Manufacturers

1. Littelfuse, Bussmann, Gould-Shawmut.

PART 3 - EXECUTION

3.1 GENERAL

A. Fuses shall not be installed until equipment is ready to be energized.

B. All fuses shall be provided by the 0.4 Contractor.

END OF SECTION 26 2813

SECTION 26 2816 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. Provide enclosed fusible disconnect switches in accordance with the Contract Documents.

1.3 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. UL Standards #98
2. NEMA KS-1

1.4 SUBMITTALS

A. Submit manufacturers' data for all disconnect switches and circuit breakers.

PART 2 - PRODUCTS

2.1 ENCLOSED SWITCHES

A. Enclosed switches shall be fused heavy-duty, single-throw knife switch with quick-make, quick-break mechanism, capable of full load operations. Meet NEMA and U.S. Government specifications for Class A switches. Install fused switches unless otherwise noted.

B. Provide with contact arc-quenching devices, such as magnetic blowouts or snuffing plates. Provide self-aligning switchblades with silver alloy contact areas and designed so that arcing upon making and breaking does not occur on the final contact surfaces. Provide with high-pressure, spring-loaded contact. Mount switch parts on high-grade insulating base. All safety switches shall be fused unless otherwise noted.

C. Enclosure: NEMA 1 with hinged door, and defeatable interlock when switch is in "On" position and can be positively padlocked in "on" and "off" positions. Utilize NEMA 3R (rain-tight) enclosure for exterior installations. NEMA 3R enclosures must be galvanized.

D. Size fusing and number of poles as shown or as required. Where fused, the devices must be provided with UL listed rejection feature to reject all but Class R fuses. Provide horsepower rated switch to match motor load if no size is shown. Use 3 pole plus solid neutral switches on four wire circuits and 3 pole switches on all other circuits unless otherwise noted.

E. Lugs must be UL listed for aluminum and/or copper conductors and be front removable.

F. Manufacturer to be the same as that for transformers, switchgear, etc.

G. Acceptable manufacturers: Square D, Cutler-Hammer, General Electric or Siemens.

2.2 MOLDED-CASE CIRCUIT BREAKERS

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

1. Cutler-Hammer
2. General Electric Company
3. Siemens
4. Square 'D'

B. General Requirements: Comply with UL489, NEMA AB1, and NEMA AB3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers for circuit breakers 100 amperes and below: inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.

D. Electronic Trip Circuit Breakers for circuit breakers 125 amperes and above: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long-and short-time time adjustments
4. Ground-fault pickup level, time delay, and I^2t response.

E. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles
2. Lugs: Suitable for number, size, trip ratings, and conductor material.

2.3 ENCLOSURES

A. Enclosed Switches: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250 Type A.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Area: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Non-corrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Each piece of equipment utilizing multi-phase power shall be supplied with a safety-type disconnect switch.

B. Each piece of equipment utilizing single-phase power and protected at over 30 amperes shall be supplied with a safety-type disconnect switch.

C. Motor disconnects other than mentioned above may utilize a toggle type manual control switch properly sized and rated for the equipment it disconnects.

D. Factory installed fused disconnect switches may be used to satisfy the above requirements with the Professional's prior approval.

3.2 MOUNTING

A. Switches or circuit breakers less than 100 pounds may be mounted on the wall. Equipment over 100 pounds shall be mounted on a rack that extends from floor to ceiling. Do not mount switches or circuit breakers to equipment housing.

END OF SECTION 26 2816

SECTION 26 4313 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the 0.4 characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into 0.4 distribution equipment such as switchboards and panelboards. Refer to related sections for surge requirements in:

1.3 RELATED SECTIONS

A. Section 262416 – Panelboards

B. Section 262413 – Switchboards – Low Voltage

1.4 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

1.5 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted through eBuilder:

1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
2. For sidemount mounting applications (SPD mounted external to 0.4 assembly), 0.4/0.2 drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. Where applicable the following additional information shall be submitted to the Professional:

1. Descriptive bulletins
2. Product sheets

1.6 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted, through eBuilder, for record purposes:

1. Final as-built drawings and information for items listed in Section 1.4 and shall incorporate all changes made during the manufacturing process.

1.7 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar 0.4 equipment for a minimum period of five (5) years. When requested by the Professional, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.8 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.9 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton Cutler-Hammer

B. Square D

C. GE

D. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Professional ten (10) days prior to bid date.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the 0.4 system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

MODES	208Y/120
L-N; L-G; N-G	700
L-L	1200

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

    a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

        1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
        2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

6. Overcurrent Protection

a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

8. Safety Requirements

a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.3 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations and switchboard assemblies as indicated on drawings. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode

C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

C. SPD Type - All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.4 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
3. The panelboard shall be capable of re-energizing upon removal of the SPD.
4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
5. The SPD where noted on drawings or in schedules shall be included and mounted within the panelboard by the manufacturer of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

B. Switchboard Requirements

1. The SPD application covered under this section is for switchboard locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchboard.
3. The SPD shall be factory installed inside the switchboard at the assembly point by the original equipment manufacturer
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD where noted on drawings or in schedules shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.5 ENCLOSURES

A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:

1. NEMA 1 – Constructed of a polymer (units integrated within 0.4 assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).

PART 3 - EXECUTION

3.1 EXAMINATION (Not Used)

3.2 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.3 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.4 WARRANTY

A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION 26 4313

DIVISION 28

ELECTRONIC SAFETY AND SECURITY

SECTION 28 3100 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

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

B. Related Sections:

1. Division 01 General Requirements
2. Division 23 Heating Ventilating and Air Conditioning Monitoring & Control
3. Division 26 Electrical

1.3 SUMMARY

A. Section Includes:

1. This specification describes an addressable Fire Detection and alarm signaling system. The control panel shall be intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques, in full compliance with all applicable codes and standards. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the successful contractor.
2. The system shall include all required hardware, raceways, interconnecting wiring and software to accomplish the requirements of this specification and the contract drawings, whether or not specifically itemized herein.
3. All equipment furnished shall be new and the latest state-of-the-art products of a single manufacturer, engaged in the manufacturing and sale of analog fire detection devices for over 35 years.
4. The system as specified shall be supplied, installed, tested and approved by the local Authority Having Jurisdiction, and turned over to the Client Agency in an operational condition.
5. In the interest of job coordination and responsibilities, the installing contractor shall contract with a single supplier for fire alarm equipment, engineering, programming, inspection and tests.
6. The system specified shall be that of Siemens Cerberus® PRO which meets the project requirements.
7. The system shall support approved smart-infrastructure integration (SII) and be capable of bi-directional data exchange with other building systems where required.

1.4 EQUIPMENT SUPPLIER

A. The campus standard for Fire Alarm is BSGI Cerb Pro Modular System. The supplier known to meet these requirements is BSGI, please contact Jed Richardson at jrichardson@bsgi.com or 610-775-1200. Berkshire Systems Group is the original installer of the existing fire alarm network system and holds the software rights to the fire alarm system. It is required that BSGI program all changes to the fire alarm system during this project. In addition, the Equipment Supplier shall have the following minimum certifications and listings:

1. A minimum of five individuals who work full time with the local office of the Equipment Supplier supporting this project who are NICET Certified in Fire Alarm Systems at Level IV. A copy of the current Certification Certificates shall be included in the Submittal Data required above.
2. The Equipment Supplier shall be listed by Underwriters Laboratories, Inc. (U.L.) under category UUJS for Protective Signaling Systems or Factory Mutual Research Approved (FM) for Fire Alarm Service – Local Companies under Standard 3011. A copy of a current Listing or Approved Certificate shall be included in the Submittal Data required above.

1.5 PROPRIETARY FIRE ALARM SYSTEM.

A. Danville State Hospital fire alarm system approved vendor is Berkshire System Group, Inc; Jed Richardson 610-775-1200.

B. The above item has been approved by the Department as a proprietary item. No other item will be accepted. Article 9, Paragraph 9.6, Substitutions of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

1.6 DEFINITIONS

A. ASME: American Society of Mechanical Engineers.

B. Broadcast Media: The speakers, radio, cell phone, and other media that will carry the selected message to the selected audience.

C. FACP: Fire alarm control panel.

D. FM: FM Global (Factory Mutual).

E. Furnish: To supply the stated equipment or materials.

F. Install: To set in position and connect or adjust for use.

G. LED: Light-emitting diode.

H. LOC: Local Operating Console.

I. MNS: Mass Notification System.

J. DMS: danger management systems (Management Station)

K. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

L. NICET: National Institute for Certification in Engineering Technologies.

M. Provide: To furnish and install the stated equipment or materials.

N. UL: Underwriters Laboratories.

O. AHJ: Authority Having Jurisdiction. Local authority (such as a fire marshal), presiding over the occupancy of the building(s).

P. VESDA: Very Early Smoke Detection Apparatus

Q. ASSD: Air Sampling Smoke Detection

R. VEWFD: Very Early Warning Fire Detection

S. ISO*technology*™: devices with built-in isolation

T. NRTL: National Recognized Testing Lab (UL, ULC, FM, ETL etc.)

1.7 SYSTEM DESCRIPTION

A. Basic Cerberus® Pro Modular System - The system shall be a complete, electrically supervised fire detection and notification system, with a microprocessor-based operating system having the following capabilities, features, and capacities:

1. Support of TechAdvance+ mobile test system capable of providing point test reports in NFPA standard format without manual report entries.
2. The control panel shall allow control and monitoring from a wireless handheld display device during maintenance, inspection and troubleshooting tasks

    a. The control panel shall allow complete control and monitoring from a wireless handheld display device during one-man testing of the system
    b. Testing supported should be real smoke testing of devices, automatically logged and made available in NFPA format reports. Manual test entries will not be accepted.

3. System shall provide an output port for monitoring purposes by external systems. Communications to an external system shall be RS-232 or RS-485 communications.
4. A single node or system shall support at least 50 remote transponders
5. The local system shall provide status indicators and control switches for all of the following functions:

    a. Audible and visual notification alarm circuit zone control.
    b. Status indicators for sprinkler system water-flow and valve supervisory devices.
    c. Any additional status or control functions as indicated on the drawings, including but not limited to: emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

6. Each intelligent addressable device or conventional zone on the system shall be displayed at the Central Alarm Receiving Terminal and the local fire alarm control panel by a unique alphanumeric label identifying its location.
7. Audio shall be synchronized between nodes in order to take into account common areas.
8. The network, audio, and telephone risers between nodes shall be copper and support Class X loop configuration to allow communication to continue in the event of a fault.
9. SVGA graphics support.
10. Built-in graphics editor.
11. Event display by color and icon.
12. Full touch screen support.
13. Multi-level passwords.
14. The system shall have the ability for multiple command centers with full control of the fire detection. (ALL)
15. Integration with building automation Management Station
16. Integration with security system (ALL)

1.8 PERFORMANCE REQUIREMENTS

A. General Performance: System devices shown shall comply with NFPA 72 and all contract documents and specification requirements.

B. The system shall have Class B (formerly style 4) circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal.

C. The system shall provide the following functions and operating features:

1. The FACP and auxiliary power panels shall provide power, annunciation, supervision and control for the system.
2. Provide Class B (formerly style 4) initiating device circuits.
3. Provide Class B (formerly style 4) notification appliance circuits. Arrange circuits to allow individual, selective, and all-call voice and visual notification by zone. Notification Appliance circuits shall be zoned to correspond with the building fire barriers and other building features.
4. Strobes shall be synchronized throughout the entire building.
5. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.

D. The system shall provide a field test function where one person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. Alarms, supervisory signals and trouble signals shall be loggedin system history during the walktest.

E. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.

F. Fire alarm signal initiation shall be by one or more of the following devices:

1. Manual pull station
2. Heat detector
3. Cerberus® PRO line of detectors including ASA line
4. Duct smoke detector
5. Automatic sprinkler system water flow switch

G. Activation of any system fire, security, supervisory, trouble, or status initiating device shall cause the following actions and indications at all network Operating units using basic graphics and multiple detail screens.

1. Fire Alarm Condition:

a. Sound an audible alarm and display a custom screen/message defining the building in alarm and the specific alarm point initiating the alarm in a graphic display.
b. Log into the system history archives all activity pertaining to the alarm condition.
c. Sound the ANSI 117-1 signal with synchronized audible and synchronized strobes throughout the facility.
d. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
e. A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
f. Activation of any smoke detector in a single elevator lobby or an elevator equipment room shall, in addition to the actions described, cause the recall of that bank of elevators to the main exit discharge and the lockout of controls. In the event of recall initiation by a detector in the main extinguishing discharge lobby, the recall shall be to the alternate floor as determined by the AHJ.

g. Where indicated on drawings, heat detectors in elevator shaft and machine rooms shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the ratings of the sprinkler heads in respective locations to ensure that the power shall be shut off before activation of sprinkler system.
h. System operated duct detectors as per local requirements shall accomplish HVAC shut down.
i. Door closure devices shall operate by fire barrier area, by floor, by local requirements or by local requirements.

2. Supervisory Condition:

a. Display the origin of the supervisory condition report at the local fire alarm control panel graphic LCD display.
b. Activate supervisory audible and dedicated visual signal.
c. Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
d. Record within system history the initiating device and time of occurrence of the event.

3. Trouble Condition

a. Display at the local fire alarm control panel graphic LCD display, the origin of the trouble condition report.
b. Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
c. Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
d. Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.
e. Trouble reports for primary system power failure to the master control shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations.
f. Record within system history: the occurrence of the event, the time of occurrence and the device initiating the event.

1.9 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.

B. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125% of the calculated requirement. Provide the following supporting information:

1. Supervisory power requirements for all equipment.
2. Alarm power requirements for all equipment.
3. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
4. Voltage drop calculations for wiring runs demonstrating worst-case condition.
5. NAC circuit design shall incorporate a 20% spare capacity for future expansion.

C. Submit manufacturer's requirements for testing Device Loop Card circuits and device addresses prior to connecting to control panel. At a minimum, the following tests shall be required: device address, the usage (alarm, supervisory etc.), environmental compensation, temperature ratings for thermal detectors and smoke detector sensitivities. This requirement shall need approval before any wiring is connected to the control panel.

D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Complete drawings covering the following shall be submitted by the contractor for the proposed system:

    a. Floor plans in a CAD compatible format at a scale of 1/8" = 1'-0" showing all equipment and raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.
    b. Provide a fire alarm system function matrix as referenced by NFPA 72, Figure A-7-5.2.2 (9). Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from these specifications and/or drawings at time of bid.

4. Installation drawings, shop drawings, and as-built drawings shall be prepared by an individual experienced with the work specified herein.
5. Incomplete submittals shall be returned without review, unless with prior approval of the Engineer.

E. The Professional shall submit deferred submissions of Fire Alarm and Mass Notification Systems plans and calculations to the Department of Labor and Industry once shop drawings are submitted and reviewed by the Professional. The submission to the Department of Labor and Industry must occur at least two weeks prior to installation. A statement signed by the Design Professional in Responsible Charge must be included with plans for either of these systems. The statement should indicate that the design professional has reviewed the shop drawings and found them to be in general conformance with the design of the building.

F. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Light fixtures
2. HVAC registers
3. Fire protection equipment interfaces
4. Special suppression system interfaces

G. Qualification Data: For qualified installer, applicator, manufacturer, fabricator, professional engineer, testing agency, and factory-authorized service representative.

H. Source quality-control reports.

I. Field quality-control reports.

J. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.

K. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications: The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.

1. FM Global (Factory Mutual (FM)):FM Approval Guide
2. National Fire Protection Association (NFPA)

    a. NFPA 70 National Electrical Code
    b. NFPA 72 National Fire Alarm Code
    c. NFPA 90A Standard for The Installation of Air Conditioning and Ventilating Systems
    d. NFPA 92 – Standard for Smoke Control Systems
    e. NFPA 2001, Standard for the installation of Clean Agent fire suppression
    f. NFPA 13, and NFPA 25
    g. NFPA 720
    h. NFPA 101 Life Safety Code

3. Underwriters' Laboratories, Inc. (UL) equipment standards, Latest Edition

    a. UL Fire Protection Equipment Directory
    b. UL Electrical Construction Materials Directory
    c. UL 38 – Manually Actuated Signaling Boxes for Use with Fire Protection Signaling Systems
    d. UL 228 – Door Holding Devices
    e. UL 268 - Smoke Detectors for Fire Protective Signaling Systems
    f. UL 268A - Smoke Detectors for Duct Application
    g. UL 464 - Audible Signal Appliances
    h. UL 497A – Secondary Protectors for Communications Circuits
    i. UL 521 - Heat Detectors for Fire Protective Signaling Systems
    j. UL 864 - Control Units for Fire Protective Signaling Systems
    k. UL 1283 – Electromagnetic Interference Filters
    l. UL 1449 - Transient Voltage Surge Suppressors
    m. UL 1971 - Signaling Devices for the Hearing Impaired
    n. UL 2572 – Mass Notification Systems

4. Underwriters Laboratories Canada (ULC)
5. International Code Council

    a. International Building Code
    b. International Fire Code

6. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction, ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.
7. California State Fire Marshal
8. NY-MEA
9. City of Chicago approvals Class 1, Class II and High Rise

10. ISO 9002

B. Supplier Qualifications

1. The manufacturer of the supplied products must utilize multi-channel product distribution on a national basis to be considered for this bid. The manufacturer must have factory branches as well as independent distributors to allow the end user with the ability to utilize factory trained and authorized competitive service providers after system installation and commissioning.
2. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be a minimum of NICET level 2 in Fire alarm and licensed in the State if required by law.
3. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the Client Agency's personnel in the system operation and maintenance.
4. The factory trained service provider shall furnish evidence they have an experienced service organization, which carries a stock of spare and repair parts for the system being furnished.
5. The manufacturer’s representative shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the air sampling system and shall be able to produce a certificate stating such upon request.

C. Installer Qualifications:

1. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type and design as specified.
2. The contractor shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.
3. The manufacturer representative shall employ on staff a minimum of one NICET certified designer, technician and/or a professional engineer, registered in the State of the installation, as required by the AHJ.
4. Manufacturer’s representatives must comply with the provisions of qualification of installers to furnish the required services.

D. Testing Agency Qualifications: Qualified for testing indicated.

E. Source Limitations for fire alarm equipment: Obtain fire alarm equipment from single source.

F. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.
3. Combustion Characteristics: ASTM E 136.

G. 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.

H. Pre-installation Conference: Conduct conference at Project site.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.

B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.12 PROJECT CONDITIONS

A. Installed products or materials shall be free from any damage including, but not limited to, physical insult, dirt and debris, moisture, and mold damage.

B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire alarm equipment that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 1 year from date of Substantial Completion.

1.14 SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for 1 year.

B. Upgrade Service: Update software, firmware, to latest version at project completion. Install and program software upgrades that become available within two years from date of substantial completion. Upgrading software, firmware shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Client Agency to allow scheduling and access to system and to allow Client Agency to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements all equipment shall be Siemens Cerberus PRO Modular as supplied by: Berkshire Systems Group, Inc. Jed Richardson – jrichardson@bsgi.com, 610-775-1200

2.2 CONTROL PANEL

A. The fire alarm control panel shall be microprocessor-based using multiple microprocessors throughout the system, providing rapid processing of smoke detector and other initiation device information to control system output functions.

B. There shall be a watchdog circuit, which shall verify the system processors and the software program. Problems with either the processors or the system program the panel shall activate a trouble signal and reset the panel.

C. The system modules shall communicate with an RS-485 network communications protocol. All module wiring shall be to terminal blocks, which will plug into the system card cage. The control panel shall be capable of expansion via up to 100 SLC's. Maximum system capacity shall be at least 2500 intelligent initiation devices per panel.

D. The system shall be capable of supporting unshielded wiring applications.

E. System Components:

1. The Device Loop Card loop shall be capable of 252 intelligent devices distributed between two SLC circuits. Any trouble on one circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. Card shall not limit the address selection for sensors and input/output devices. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on-board microprocessor provides the Device Loop Card loop with the ability to function even if the main microprocessor fails. LEDs on the board shall provide annunciation for the following: Power, Card Failure, Network Failure, Gnd. Fault, Alarm, Trouble, Short Zone 1, Short Zone 2, Class A Open Zone 1, and Class A Open Zone 2. The Device Loop Card shall support X-Series I/O modules with build-in isolation capability. The system display shall provide the specific device (X-Series) which has detected a loop short trouble, when a loop short is present anywhere on the data communication circuit. This card shall plug into the system card cage. The card shall be model number XDLC.
2. The Signal Line Circuits (SLC) shall be tested for opens, shorts and communications with all addressable devices installed before connection to the control panel. Systems without this capability shall have a test panel installed for initial testing to eliminate any possible damage, short term or long term, to the control panel. After initial testing replace the test panel and proceed with complete testing.
3. The Operator Interface shall provide the system information on hi- resolution ¼ VGA Color LCD, with Touch Screen and LED display. Event Color is user defined and specific for each event type i.e., MNS, Fire Alarm, Gas, Trouble, etc. Graphic user interface shall be menu driven with tabs showing the level and the total events for each tab. The tabs shall be: Alarm, Supervisory, Trouble and Security. At least five (5) events shall be shown simultaneously with two full lines of text message for each event. Each event shall have a 32-character custom message describing the event's location. In addition, the time stamp and category of the event (i.e., Smoke, Water flow, Manual, etc.) shall be displayed. When configured for Canadian operation, nine (9) events shall be displayed simultaneously. The LED displays shall indicate Power, Audibles On or Silenced, and Partial System Disabled. Systems not having the above LEDs shall provide separate LEDs within the control panel enclosure with appropriate labels. Selection buttons shall be backlit to aid the operator in the selection process. There shall be controls for scrolling throughout the event list. A button shall provide zoom in and zoom out control for the amount of information desired for a specific entry. The operator interface shall be capable of monitoring the power supply loading and show available capacity for future expansion planning. The operator interface shall provide a "More Info" button which can display addition device information such as a graphical map of the event, its device type and system address. This More Info button shall also have the ability to display a detailed screen that provides the following:

    a. 200-character custom message associated with the group of the device and physical location in the building to alert personnel
    b. NFPA symbols representing fire service equipment in the area
    c. NFPA symbols representing hazards in the area

d. NFPA symbols representing people in the area
e. Number of devices in the associated group that are in alarm
f. Name and phone number of emergency contact

4. The operator interface shall also have the ability to display a bitmap of a floor plan showing a “You are Here” symbol to tell the responding person exactly where they are in the building in relation to the event. Systems without this type of display shall supply a UL listed Graphics package with their system. The LCD shall have a keyboard screen to allow the technician ability to enter test and numbers for passwords or text changes. The operator interface shall also have a Context Sensitive Help button. A globally configured operator interface shall have the ability to view events, acknowledge, silence and reset networked Cerberus® Pro Modular and Siemens MXL systems. A globally configured operator interface shall also have the ability to arm and disarm input and output points on Siemens Cerberus® Pro Modular and Siemens MXLs systems. A globally configured operator interface shall have the ability to be configured for control of the entire network, control of the local FACP System, or annunciation only. In a networked configuration, the Partial System Disable LED shall be indicative of all networked Siemens FACPs. A globally configured operator interface in a networked configuration shall have the ability to store 6 maps for every Cerberus® Pro Modular panel. Capable of at least 10 globally configured operator interfaces shall be supported in a network. The operator interface International (International Version) shall provide Spanish, Portuguese or Canadian overlays. The operator interface shall have the ability to be configured display text in Spanish, Portuguese, Hebrew or French while having the ability to swap in English text at anytime by a simple button press at the panel. The module shall be model number FCM2041-U3.
5. The Zone Indicating Card shall contain four (4) NAC circuits rated at 4 amps each with power-limited outputs. The zone inputs for the card shall be isolated and independently supervised. There shall be at least four (4) unique codes/signals for each circuit based on system logic. These signals shall be Temporal Code 3 (Evacuation), Temporal Code 4, Steady (such as “Recall”) and Alert (such as “Tornado Alert”). The card shall be listed for notification appliances, horns, bells, strobes, and speakers. The card shall also be listed for NFPA 13 Pre-Action Release, FE-227ea and NOVEC1230, Lease Line, and Municipal Tie. The card shall have the ability to wire the circuits Class A or Class B with outputs synchronized. The card shall have the following LEDs to provide trouble shooting and annunciation: Power, Card Failure, Network Failure, Gnd. Fault, Zone Activation or Trouble. This card shall plug into the system card cage. The card shall be model number ZIC-4A.
6. The Zone Indicating Card shall contain eight (8) NAC circuits rated at 2 amps each with power-limited outputs. The zone inputs for the card shall be isolated and independently supervised. There shall be at least four (4) unique codes/signals for each circuit based on system logic. These signals shall be Temporal Code 3 (Evacuation), Steady (such as “Recall”), and Alert (such as “Tornado Alert”). The card shall be listed for notification appliances, horns, bells, strobes, and speakers. The card shall have the ability to wire the circuits Class B with outputs synchronized. The card shall have the following LEDs to provide trouble shooting and annunciation: Power, Card Failure, Network Failure, Gnd. Fault, Zone Activation or Trouble. This card shall plug into the system card cage. The card shall be model number ZIC-8B.
7. The Control Relay Card shall contain six (6) fully programmable relays each rated at 4A, 30 VDC / 120VAC resistive and 3.5A, 120VAC 0.6 PF inductive. The card shall have the following LEDs to provide trouble shooting and annunciation: Power, Card Fail, HNET Fail, Relay 1 Active, Relay 2 Active, Relay 3 Active, Relay 4 Active, Relay 5 Active, and Relay 6 Active. The card shall be model number CRC-6.
8. The system card cage shall provide the mounting of all system cards, field wiring, and panel’s inter-card wiring. All power limited field wiring shall connect to the top of the card cage. All non-power limited internal wiring shall be connected to the bottom of the card cage. The card cage shall hold the systems cards and have capability of connecting

multiple card cages to meet system demands. All terminal blocks are removable. The card cage shall be model number CC-2 or CC-5.

9. The Supervised Input Module shall provide sixteen input circuits for remote system monitoring. Each input shall have the ability to be individually programmed as supervised (dry contact only) or unsupervised (general purpose input). The Supervised Input Module shall provide two programmable Form C relays. The Supervised Input Module shall be mountable in an enclosure that is remotely located from the main control panel. The Supervised Input Module shall be capable of supervising inputs 500ft away. The module shall be model number SIM-16.
10. The Output Control Module shall provide sixteen open collector outputs to drive LEDs, incandescent lamps or external relays. There shall also be an additional output for a local audible and two inputs for momentary lamp test as well as local audible silence switches. The Output Control Module shall be mountable in an enclosure that is remotely located from the main control panel. The module shall be model number OCM-16.
11. The Switch Control Module shall be a supervised module with eight (8) switches and two LEDs per switch for controlling such items as speaker/strobe or telephone circuits. The switches shall also be used as generic inputs into the system. The Switch Control Module shall be mounted in the door for easy access. These modules shall be connected to the control area network and have a maximum distance of 1000 ft. The module shall be model number SCM-8.
12. The LED Control Module shall contain eight (8) groups of two (2) LEDs that shall be programmable by Zeus programming software. Eight LEDs shall be dual color capable that can be lighted either RED or GREEN flashing or steady. The remaining LEDs shall be amber color, flashing or steady. A space shall be provided for labeling of LED functions. The label shall slide behind a clear protective membrane. The LED Control Module shall be mounted in the door for easy access. These modules shall be connected to the control area network and have a maximum distance of 1000 ft. The module shall be model number LCM-8.

F. System response time from alarm to output shall be an average of three (3) seconds.

G. To expedite system troubleshooting, the system cards shall have ground fault detection and diagnostic LEDs by card.

H. All system cards and modules shall have Flash memory for downloading the latest module firmware.

I. Passwords:

1. Maintenance/Control Password - There shall be a 5-character password that a user must enter into the control panel in order to perform such maintenance- and control-related functions at the panel as:

    a. Arming and disarming devices.
    b. Activating, deactivating or modifying detector ASD and sensitivity settings.
    c. Activating and deactivating the History Log function, and deleting obsolete entries.
    d. Changing the system time and date.

2. Function Key Password - There shall be a 5-character password that a user must enter into the control panel in order to access the panel's Function Keys: touch screen buttons which perform custom-programmed system functions.
3. Reports Password - There shall be a 5-character password that a user must enter into the control panel in order to access the panel's reporting functions.
4. Walktest Password - There shall be a 5-character password that a user must enter into the control panel in order to access the panel's walk testing functions.

5. Acknowledge Silence Reset Password - There shall be a 5-character password that a system user must enter into the control panel in order to acknowledge events, turn silenceable audibles and visuals on and off, and perform panel resets.

J. Degrade Mode Alarm Activation:

1. Each data gathering panel shall support the ability to have its corresponding ZIC-4A, ZIC-8B and output devices on a DEVICE LOOP CARD 's loop activate when the DEVICE LOOP CARD or CDC-4 is in Degrade Mode (has lost HNET communication with the OPERATOR INTERFACE control panel). For example, if the device loop includes HFP detectors with relay bases and lamps, the relays and lamps will activate upon any system alarm when the DEVICE LOOP CARD is in Degrade Mode.

K. Software Modifications: The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made. Systems that require the use of external programmers or change of EPROMs are not acceptable.

L. Logic: The fire alarm system shall support generic functions that deal with binary states (True/False, high/low), and produce desired outputs from one or more binary inputs (for example, alarm outputs from spot detectors, VESDA detectors, monitor modules or manual station inputs). AND, OR, NOT, Any N, D Latch, RS Latch, Time Base Control, Start Timer, Restart Timer are generic functions. Generic functions can be used as inputs to other function. The system shall support 2500 logic functions.

M. History: The system shall store 5000 events in history while in straight mode and 4500 in circular mode. In straight mode, trouble warnings will occur at 4000 and 4500 events. In circular mode, the control panels shall maintain a 2000 event Alarm History buffer, which consists of the 2000 most recent alarm events from the 4500-event history file.

N. Reports:

1. The system shall have the ability to provide configuration, status, queue and history reports.
2. Configuration reports shall provide the following information:

    a. Custom Messages
    b. Database information
    c. Entity type
    d. Device usage
    e. Device category
    f. Firmware revision

3. Status reports shall provide the following information:

    a. Disarmed cards and devices
    b. ASD settings
    c. Sensitivity in %/foot
    d. Alarm threshold in %/foot
    e. Temperature in degrees F
    f. LOW TEMP DETECTOR Condition
    g. Walktest

4. Queue reports shall provide the following information:

    a. Alarm events with custom message and event time

b. Supervisory events with custom message and event time
c. Security events with custom message and event time
d. Trouble events with custom message and event time

5. History reports shall provide Address, History Type, Description, Time & Date and Custom Message. The following event types shall be reported:

a. Alarm events
b. Supervisory events
c. Security events
d. Status changes
e. Alarm verification
f. Output activation from logic
g. System Reset
h. Event Acknowledgements
i. Block Acknowledgements
j. Audible Silence System Flag Changes
k. Sensitivity Changes
l. Arm / Disarm Commands
m. Arm / Disarm By Logic
n. Manual Output Overrides
o. Output Overrides By Logic
p. Time Changes
q. Menu Logins
r. ASD Changes
s. Walktest
t. Device Input to Logic Activations/Deactivations

2.3 POWER SUPPLY

A. The system Power Supply/Charger (PSC) shall be a 12-amp supply with battery charger. The power supply shall be filtered and regulated. The power supply shall have a minimum of 1 power limited output rated at 4 amps, and a minimum of 1 output rated at 12 amps. The system power supply can be expanded up to 48 amps. The auxiliary power supply module shall share common batteries with the primary power supply. The system power supply shall have 4 relays, 1 for common alarm, one for common trouble and two programmable relays. The power supply shall be rated for 120/240VAC 50/60Hz. The module shall be model number PSC-12 or an extender power supply (PSX-12) shall be available for additional system power requirements

B. The battery charger shall be able to charge the system batteries up to 100AH batteries. Battery charging shall be microprocessor controlled and programmed with an optional Thermistor for monitoring battery temperature to control charging rate shall be available.

C. The power supply shall have a plug for an AC adapter cable, which allows a technician to plug in a laptop computer for up or downloading program information or test equipment.

D. Transfer from AC to battery power shall be instantaneous when AC voltage drops less than 90% or brown out conditions it is not sufficient for normal operation.

2.4 REMOTE POWER SUPPLY FOR NON-VOICE NOTIFICATION APPLIANCES

A. The PAD-5 power supply unit shall be used with a Siemens Cerberus® PRO Fire Safety Modular System. It shall an addressable NAC distributed controller to provide power to visual strobe circuits or supply auxiliary power to such items as Door holder circuits. The PAD-5 shall communicate on the SLC loop to the Siemens Cerberus® PRO Fire Safety Modular Control Panel. It shall provide status monitoring, device level fault indications and individual NAC control

using a single address on the SLC. The PAD-5 unit shall provide a constant 24VDC nominal output voltage to each NAC-independent of voltage fluctuations on the primary or secondary power source.

B. The PAD-5 or PAD-4 shall be a self-contained unit with 24VDC power supply and batteries housed in its own locked enclosure. Enclosure shall be made of 16 GA cold rolled steel, lockable and having the same key as the other control enclosures. Shall have 2 sizes (1 unit and a 2 unit) and colors (red and black).

C. The power supply shall be UL 864 listed and available in 6A and 9A models and 120 or 240VAC.

D. The power supply be able to support up to 18AH batteries in a single unit and 35AH in a 2-unit enclosure. Shall be able to support up to 100AH batteries in a separate enclosure.

E. The power supply shall have four independent 3 amp rated NAC circuits, expandable to a total of eight (8) Class B or four (4) Class A circuits or a mixture of each with an expansion CLSA card.

F. The power supply shall have the ability to add one of two types of expansion cards which take one additional address on the SLC:

1. CLSA expansion card provides additional NAC circuits and can be configured with two (2) Class B or one (1) Class A releasing circuits with on board service disconnect switches.
2. CDC Conventional Zone Module is an expansion card that provides for four (4) Class A or B conventional detection zone input circuit or shorting device (non-alarm) input circuits

G. The power supply shall be a class X isolating device residing on the SLC loop.

H. Each NAC output can be configured as an Aux Power output or a non-alarm closure input circuit.

I. Complete status monitoring to the individual circuit level at the main FACP and on-board LED status and diagnostic indicators.

J. The PAD-5 is fully configurable through the Siemens Fire Safety Modular system configuration tool.

K. Output Circuits can be configured individually as Steady On, Temp 3, Temp 4, March Time 30, 60 or 120PPM.

L. All NAC circuits have synchronized strobe outputs, any combination of PAD-5 Main Boards and Expansion cards up to 32 can be synchronized on the same XDLC loop.

M. A dedicated Bell Follower circuit can be used to achieve synchronization across multiple SLC loops.

N. Shall be able to accept a range of End of the Line (EOL) resistor values (2.2K to 24KΩ) without having to program or configure unit.

2.5 SYSTEM ENCLOSURE

A. Enclosure needed to hold all the cards and modules as specified with at least spare capacity for extra cards. The enclosure outer door shall be either black or red. Provide the color as to the local AHJ requirements. The outer doors shall be capable of being a left hand open or a right hand open. The inner door shall have a left-hand opening. System enclosure doors shall provide where required ventilation for the modules or cards in the enclosure.

B. Provide system enclosure for all amplifiers. Where required by the manufacturer, provide means for venting heat from the enclosure either by having enclosure sides and top vented or the doors vented.

2.6 INTELLIGENT INITIATING DEVICES

A. General

1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections. Except when built in isolation ISO*technology*™ is used polarity sensitivity is required for the devices configured in isolation mode.

B. Smoke Detectors – Advanced Addressable OOH-Series

1. The detectors shall be guaranteed in writing not to false alarm when configured by the factory trained certified technician. The detectors must provide at least 19 different environmental algorithms that allow the detector to provide superior false alarm immunity without the need for additional alarm verification delays.
2. The detectors shall have a tri-color LED to streamline system maintenance/inspection by plainly indicating detector status as follows: green for normal operation, amber for maintenance required, red for alarm.
3. Detectors shall utilize state of the art forward/backward light scattering technology, with improved detection for smoldering and flaming fire signatures. The detectors shall replace the need for ionization detectors due to improved response characteristics to flaming fires.
4. The CO sensor of the model OOHC941 has a 10-year lifetime from the date of installation.
5. Detectors shall provide pre-alarm signal at 0.2% obs/ft. and a full alarm at 1.0% obs/ft. to meet the performance requirements of NFPA 76 - National Fire Protection Association Standard 76, Fire Protection of Telecommunications Facilities as a Very Early Warning Fire Detector (VEWFD).
6. The forward/backward light scattering technology shall provide improved immunity to spurious activation (deceptive phenomena). The detectors shall have a “No False Alarm Guarantee”.
7. The detectors shall be RoHS-compliant: it shall meet standards for Reduction of Hazardous Substances (RoHS) by reduction in lead content and other restricted substances.
8. The multi-criteria fire detectors shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, in-duct installation and sampling assembly installation and shall be insensitive to air velocity changes. The detectors’ communications shall allow the detectors to provide alarm input to the system and alarm output from the system within four (4) seconds. So as to minimize the effort required by the installing and maintenance technician to appropriately configure the detector to ensure optimal system design, the detectors shall be programmable as application specific. Application settings shall be selected in software for a minimum of 19 environmental fire profiles unique to the devices installed location.
9. The detectors shall be designed to eliminate the possibility of false indications caused by dust, moisture, RFI/EMI, chemical fumes and air movement while factoring in conditions of ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the alarm decision to give the earliest possible real alarm condition report.
10. The detectors shall be capable of being field programmed for simultaneous and /or independent functionality, depending on the application. For example, the detectors shall be capable of utilizing the optical, heat, and/or CO sensors together for enhanced fire detection (multi-criteria) and simultaneously provide independent outputs for CO gas life-safety, smoke, and heat detection. Any combination of the sensors is possible.
11. The detectors shall be UL listed for operation in a 95% relative humidity (RH) environment.
12. The detectors shall be designed to eliminate calibration errors associated with field cleaning of the chamber.

13. The detectors shall support the use of a relay, or LED remote indicator without requiring an additional software address. Low profile, white case shall not exceed 2.5in of extension below the finish ceiling.
14. The detectors shall support the use of an ambient temperature warning signal at the panel. This temperature shall be user-configurable for the set temperature of the warning and the event type generated by the warning. This event can be used to trigger system logic.
15. For the detectors where required, there shall be available a locking kit and detector guard to prevent unauthorized detector removal.
16. UL Listed as “direct in-duct” mounting.
17. Available models:

    a. OOH941. Multi-Criteria incorporating 2 Optical sensors and 2 Thermal sensors with an operating temperature range of 32□F to 120□F (0□C to 49□C). Nineteen selectable profiles. Polarity insensitive installation wiring. Three color LED.

C. Heat Detectors – Addressable

1. Thermal Detectors shall be rated at 135□F (8.3□C) fixed temperature and 15□F (8.3□C) degrees per minute rate of rise. Detectors shall be constructed to compensate for the thermal lag inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 135□F (8.3□C). The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement.
2. The detectors furnished shall have a listed spacing for coverage up to 2,500 square feet and shall be installed according to the requirements of NFPA 72 for open area coverage. The thermal detector shall be model number HI921.
3. Model HI921 heat detector shall have the following temperature settings:

    a. Fixed temperature at 135□F (57□C), 145□F (63□C), 155□F (68□C), 165□F (74□C), 174□F (79□C)
    b. Rate of Rise at 15□F/min (8.3□C) at 135□F (57□C)
    c. Rate of Rise at 15□F/min (8.3□C) at 174□F (79□C)
    d. Low temperature warning at 40□F (4.4□C)

D. Duct Smoke Detectors – Addressable

1. For duct detector applications, the smoke detector shall be an intelligent digital photoelectric detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes.
2. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. The detector shall be mounted in a duct detector housing listed for that purpose. The duct detector shall support the use of a remote test switch, relay or LED remote indicator. The duct detector shall be supplied with the appropriate sampling tubes to fit the installation.
3. Where duct detectors are exposed to the weather a weatherproof enclosure shall be available. A NEMA-3R and NEMA-4X option shall be available. The duct housing cover shall include a test port for functional testing of the detector without cover removal. The duct housing shall include a cover removal switch capable of indicating cover removal status to the fire alarm control panel.
4. The intelligent duct detector shall have a model number from the FDBZ-Series. Where required there shall be available a duct housing with an on-board relay. Also, where required, there shall be a standalone housing available with its own power supply and test/reset switch that does not require connection to a fire alarm control panel. It shall be model FBZ492-PR.

5. Duct smoke detector housing shall allow use in duct systems with air velocity ranging from 100 to 4000f/min (0 to 20m/s), within temperature ranges of 32□F to 120□F (0□C to 49□C), and with relative humidity ranging from 0 to 95%.
6. Duct Housings and Accessories:

    a. FDBZ492 Global Air Duct Housing for Conventional and Addressable Detectors
    b. FDBZ492-HR Global Air Duct Housing for Addressable P2 Detectors with Relay Application
    c. FDBZ492-R Global Air Duct Housing for Conventional Detectors with Relay Application
    d. FDBZ492-RP Global Air Duct Housing for Conventional Detectors with Relay Application and Built-in Power Source
    e. FDBZ-WP Weather-Proof housing to accommodate all versions of Global Air Duct Housings
    f. FDBZ-RTL Remote Test Lamp for Conventional Detectors

E. Detector Bases – Addressable

1. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4in square or octagonal electrical outlet box.
2. Multi-Criteria Fire Detector Model OOHC941 shall be listed as providing CO detection in duct application.
3. The model number for the standard base shall bedB-11 - 6in version.
4. The model number for the standard base shall bedB-11E - 4in version.

F. Manual Pull Stations – Addressable

1. Provide addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel. The manual station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds.
2. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.
3. The single action pull station shall be model number XMS-S. It shall provide built-in isolation capability with ISO*technology*™. The operator display shall indicate which specific device has detected a wiring fault on the data communication line.
4. Where required, there shall also be available pull stations with break glass, capable of explosion proof installation, capable of weatherproof installation, reset key operation, and metal housings.

G. Adressable Interface Devices

1. Addressable Interface Devices shall be provided to monitor inputs (contacts) and control outputs (relays) to and from the fire alarm system and associated devices. These interface devices shall be able to monitor single or dual contacts. An address will be provided for each contact. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive. The addressable interface modules shall be model FDCIO Series, XTRI Series, ILED-X series, TSM-1X or HCP series. These devices shall have built-in isolation feature ISO*technology*™.
2. Where needed, a Conventional Zone Module shall connect to the Signal Line Circuit, which will allow the use of conventional initiation devices. This module shall have the ability to

support up to 15 conventional smoke detectors and an unlimited number of contact devices. The module shall be model HZM.

3. Model XTRI Series shall provide input and outputs as needed by specific model number. The device shall also provide built-in isolation capability with ISO*technology*™. The operator display shall indicate which specific device has detected a loop short on the data communication line.
4. Model FDCIO422 device shall provide built-in isolation capability with ISO*technology*™. The addressable input/output module shall be insensitive to polarity except when built in isolation ISO*technology*™ is used in which case polarity sensitivity is required for the devices configured in isolation mode. Additionally, the FDCIO422 shall have the capability for up to 4 separate inputs (Class B) or 2 separate Class A inputs and 4 separate outputs (Class B).
5. Model ILED-X addressable remote LED alarm indicators shall provide a visual notification for remote or concealed initiating devices. The device shall also provide built-in isolation capability with ISO*technology*™.
6. Model TSM-1X addressable remote test switch shall provide an addressable normally open (N.O.) momentary switch with a tricolor light-emitting diode (LED) indicator. The LED indicator shall provide visual notification of the status of the tested device. The device shall also provide built-in isolation capability with ISO*technology*™.
7. Model HCP addressable control point shall provide remote, independent control of a single device.
8. Monitoring applications include (but not limited to):

    a. Water-flow switches
    b. Tamper switches
    c. PIV switches
    d. Damper position – All 3 states on one input
    e. Conventional devices (e.g., Smoke detectors, beam detectors, flame detectors, etc.)
    f. Duct Detectors

9. Control applications include (but not limited to):

    a. Notification appliance circuits (NAC)
    b. Telephone zones
    c. Speaker zones.
    d. Damper position
    e. Solenoids for sprinklers

10. Where applicable, all interface devices shall meet NFPA 72 Class X requirements for survivability.

2.7 DEVICE PROGRAMMING UNIT

A. Device Programming Unit: The programming tool shall program the intelligent devices with addresses. The unit shall test the device to respond to its address. Dipswitches and rotary switches shall not be acceptable. The programmer shall be model DPU with carrying case.

2.8 ADVANCED FIRE ALARM NOTIFICATION APPLIANCES (LED BASED)

A. Series SLHW, SLSW, SLHSW Wall Horns, Strobes, and Horn/Strobes

1. The notification appliances shall be Siemens SLHS Audible Strobe appliances with LED strobe, SLSW Visual Strobe appliances with LED strobe, and SLHW Audible appliances for wall-mount applications
2. SLSW and SLHSW Strobes and horn/strobes shall be listed for UL Standard 1971 (Emergency Devices for the Hearing Impaired) for Indoor Fire Protection Service.

3. The SLHW and SLHSW Audibles shall be UL Listed under Standard 464 (Fire Protective Signaling).
4. All Series shall meet the requirements of FCC Part 15 and ICES-003.
5. The SLHSW Audible Strobe and SLSW Strobe appliances shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range and shall incorporate a Light Emitting Diode (LED) as the light source with a rugged Lexan® lens.
6. The appliances shall be of low current design.
7. The LED strobe flash duration shall be 20ms. Where Multi-Candela appliances are specified, the strobe intensity shall have 4 field selectable settings at 15, 30, 75, and 110 candela for wall mount applications.
8. The selector switch for selecting the candela shall be tamper resistant.
9. Appliances with candela settings shall show the candela selection in a visible location at all times when installed.
10. The audible shall have a minimum of two (2) field selectable settings for dBA levels and shall have a choice of continuous or temporal (Code 3) audible outputs.
11. The SLHSW Audible Strobe, SLSW Strobe, and SLHW Audible mounting options shall include LED backboxes, single-gang backbox and to 4in square with adapter kit.
12. All notification appliances shall be backwards compatible with Siemens' legacy notification appliances.
13. The SLHSW, SLSW and SLHW wall models shall have a low profile measuring 4.53ft (115mm) H x 2.76in (70mm) W x 1.27ft (32mm) D .
14. Synchronization is possible when using the DSC sync modules, Cerberus® PRO Modular panel, FC901, FC922-924, FV922-924, or PAD series power supply with built-in sync protocol
15. The strobes shall not drift out of synchronization at any time during operation. If the sync protocol fails to operate, the strobe shall revert to a non-synchronized flash rate and still maintain (1) flash per second over its Regulated Voltage Range.
16. The appliance shall also be designed so that the audible signal may be silenced while maintaining strobe activation

B. Series SLHC, SLSC, SLHSC Ceiling Horns, Strobes, and Horn/Strobes

1. The notification appliances shall be Siemens SLHS Audible Strobe appliances with LED strobe, SLSC Visual Strobe appliances with LED strobe, and SLHC Audible appliances for ceiling-mount applications
2. SLSC and SLHSC Strobes and horn/strobes shall be listed for UL Standard 1971 (Emergency Devices for the Hearing Impaired) for Indoor Fire Protection Service.
3. The SLHC and SLHSC Audibles shall be UL Listed under Standard 464 (Fire Protective Signaling).
4. All Series shall meet the requirements of FCC Part 15 and ICES-003.
5. The SLHSC Audible Strobe and SLSC Strobe appliances shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range and shall incorporate a Light Emitting Diode (LED) as the light source with a rugged Lexan® lens.
6. The appliances shall be of low current design.
7. The LED strobe flash duration shall be 20ms. Where Multi-Candela appliances are specified, the strobe intensity shall have 4 field selectable settings at 15, 30, 75, and 95 candela for ceiling mount applications.
8. The selector switch for selecting the candela shall be tamper resistant.
9. Appliances with candela settings shall show the candela selection in a visible location at all times when installed.
10. The audible shall have a minimum of two (2) field selectable settings for dBA levels and shall have a choice of continuous or temporal (Code 3) audible outputs.
11. The SLHSC Audible Strobe, SLSC Strobe, and SLHC Audible mounting options shall include LED Ceiling backboxes, 4in square, 1-1/2 or 2-1/8in deep and 4in Octagonal, 1-1/2in or 2-1/8in deep.

12. All notification appliances shall be backwards compatible with Siemens' legacy notification appliances.
13. The SLHSC, SLSC and SLHC ceiling models shall have a low profile measuring 6.26in (159mm) Diameter with 1.5in (38mm) D.
14. Synchronization is possible when using the DSC sync modules, Cerberus® PRO Modular panel, FC901, FC922-924, FV922-924, or PAD series power supply with built-in sync protocol
15. The strobes shall not drift out of synchronization at any time during operation. If the sync protocol fails to operate, the strobe shall revert to a non-synchronized flash rate and still maintain (1) flash per second over its Regulated Voltage Range.
16. The appliance shall also be designed so that the audible signal may be silenced while maintaining strobe activation

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

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

3.2 INSTALLATION

A. Perform work in accordance with the requirements of NFPA 70, NFPA 72, NFPA 13, NFPA 2001, and NECA 1-2006, Standard of Good Workmanship in Electrical Contracting.

B. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.

C. In the event that limited energy cable installation is allowed, all cable runs shall be run at right angles to building walls, supported from structure at intervals not exceeding 3ft (1m) and where installed in environmental air plenums, be rated for such use and tied/supported by components listed for environmental air plenums installation.

D. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

E. Wiring Integrity and survivability requirements – Specify on shop drawings per NFPA72, Chapter 12

F. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

H. Provide primary power for each panel from normal/ emergency panels as indicated on the Electrical Power Plans. Power shall be 120VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices.

3.3 BOXES, ENCLOSURES AND WIRING DEVICES

A. Boxes shall be installed plumb and firmly in position.

B. Extension rings with blank covers shall be installed on junction boxes where required.

C. Junction boxes served by concealed conduit shall be flush mounted.

D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.

E. "Fire alarm system" decal or silk-screened label shall be applied to all junction box covers.

F. Panel enclosures shall be installed to meet clearance requirements per NFPA 70 and local codes. Minimum requirements shall be 3ft (1m) clearance in front of the enclosure

3.4 CONDUCTORS

A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2in of the wire termination. Marker legends shall be visible.

B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.

C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, signal line circuits; 18 AWG twisted shielded, speaker circuits; 18 AWG twisted, telephone circuit; 18 AWG twisted shielded.

D. Wiring for clean agent and pre-action releasing shall be in accordance with NFPA 13 and NFPA 2001

E. All splices shall be made using solder-less connectors. All connectors shall be installed in conformance with the manufacturer recommendations.

F. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.

G. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.

H. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

3.5 DEVICES

A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.

B. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

C. All devices and appliances shall be mounted to or in an approved electrical box.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.

C. A consistent color code for fire alarm system conductors throughout the installation.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Testing General:

1. All Alarm Initiating Devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
2. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.
3. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.
4. Test reports shall be delivered to the acceptance inspector as completed.
5. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum for conducting the tests:

    a. Ladders and scaffolds as required to access all installed equipment.
    b. Multi-meter for reading voltage, current and resistance.
    c. Two-way radios and flashlights.
    d. A manufacturer recommended device for measuring air flow through air duct smoke detector sampling assemblies.
    e. Decibel meter
    f. Intelligibility meter
    g. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the authority having jurisdiction.

3.8 ACCEPTANCE TESTING

A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the engineer in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.

B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.

C. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.

D. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Client Agency and test results recorded for use at the final acceptance test.

E. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.

F. Testing requirements for pre-action systems in accordance with NFPA13

G. Testing requirements and room integrity testing for clean agent suppression systems refer to NFPA 2001.

H. Final Acceptance Test: Notify the Client Agency in writing when the system is ready for final acceptance testing. Submit request for test at least 30 calendar days prior to the test date. A final acceptance test will not be scheduled until the loop resistance test results, and the submittals required in Part 1 are provided to the Client Agency. Test the system in accordance with the procedures outlined in NFPA 72.

1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
2. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
4. Visually inspect all wiring
5. Verify with all parties the required survivability of wiring, raceways, and junction boxes
6. Verify that all software control and data files have been entered or programmed into the FACP.
7. Verify that Shop Drawings reflecting as-built conditions are accurate. Upon final approval by all parties, provide two sets of As-built documents in a cabinet adjacent to the main FACP or designated area within the building. Per NFPA 72 7.7.2Measure the current in Notification appliance circuits under full load to assure that there is the calculated spare capacity for every circuit.
8. Measure voltage readings for circuits to assure that voltage drop does not exceed specified design requirements.
9. Field Verify and measure the voltage drop at the most remote appliance on each notification appliance circuit.

I. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:

1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:

    a. Open, shorted and grounded signal line circuits.
    b. Open, shorted and grounded notification, releasing circuits.
    c. Primary power or battery disconnected.

2. System notification appliances shall be demonstrated as follows:

    a. All alarm notification appliances actuate as programmed
    b. Audibility and visibility at required levels.
    c. VOICE Intelligibility measurements at the time of commissioning and with a follow up inspection six months after substantial competition to verify conditions

3. System indications shall be demonstrated as follows:

    a. Correct message display for each alarm input at the control display.
    b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.
    c. Correct history logging for all system activity.

4. System off-site reporting functions shall be demonstrated as follows:

    a. Correct zone transmitted for each alarm input
    b. Trouble signals received for disconnect

5. Secondary power capabilities shall be demonstrated as follows:

    a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
    b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
    c. System battery voltages and charging currents shall be checked at the fire alarm control panel.

3.9 DOCUMENTATION

A. System documentation shall be furnished to the Client Agency and shall include but not be limited to the following:

1. System record drawings and wiring details including one set of reproducible drawings, and a CD ROM with copies of the record drawings in DXF format for use in a CAD drafting program.
2. System operation, installation and maintenance manuals.
3. System matrix showing interaction of all input signals with output commands.
4. Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.
5. System program showing system functions, controls and labeling of equipment and devices.
6. All applicable NFPA 72 commissioning reports.

3.10 PROTECTION

A. Remove and replace devices and panel components that are wet, moisture damaged, or mold damaged.

3.11 DEMONSTRATION

A. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing

and maintenance of the system provided. The instructor shall train the employees designated by the Client Agency, in the care, adjustment, maintenance, and operation of the fire alarm system.

B. Training sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the Client Agency.

C. Required Instruction Time: Provide 16 hours of instruction after final acceptance of the system. The instruction shall be given during working hours on such dates and times as are selected by the Client Agency. The instruction may be divided into two or more periods at the discretion of the Client Agency. One training session shall be videotaped by the contractor. Required Client Agency format shall be delivered to the Client Agency.

D. Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory and trouble. The instructions shall be approved by the Client Agency.

E. Comprehensive system troubleshooting training shall be provided for a single individual designated by the Client Agency. This session shall be separate and distinct from the above-described sessions.

F. All training sessions shall be conducted following final system certification and acceptance. Three additional training sessions shall be provided for all security personnel on all shifts six months after final system certification.

G. All training sessions shall be conducted by an authorized fire alarm system distributor representative, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided.

END OF SECTION 28 3100