APPENDIX 8

6.1 MEP/FP Conceptual Systems Narrative

HVAC

.

Electrical

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Plumbing

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Fire Protection

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Code

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Commissioning

Florence Roche Elementary School
342 Main Street
Groton, MA 04150

MEP/FP

Conceptual Systems Narrative

PDP Submission

January 24, 2020

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I. INTRODUCTION

This report has been compiled to assist MSBA, Groton Dunstable School District, Studio G Architects and the project team in understanding the proposed scope of work, system configurations, and associated cost implications for the HVAC, Electrical, Plumbing and Fire Protection Systems for the renovation and new building options for the FRES project. The building floor area will be approximately 98,000 gross square feet.

Design options for costing are as follows:

- Option 1 – Chilled and hot water systems with all VAV air handlers
- Option 1b – Chilled and hot water systems with fan coils in the existing building and VAV air handlers in the addition
- Option 2 – Chilled and hot water systems with Displacement Ventilation air handlers
- Option 2b – Chilled and hot water systems with fan coils in the existing building and with displacement ventilation air handlers in the addition
- Option 3 – Variable Refrigerant Flow

II. SUSTAINABLE STRATEGIES

A. Goals

1. Specific design and environmental sustainability goals as they relate to the mechanical, electrical, plumbing, and fire protection systems have been incorporated based upon the requirements of the US Green Building Council's LEED® Rating System.

2. Leadership in Energy and Environmental Design (LEED) is a nationally accepted green building rating system used to benchmark high performance buildings. Projects are awarded Certified, Silver, Gold, or Platinum certification depending on the number of credits they achieve. We understand that the Owner has targeted LEED for Schools V4 certification.

B. Approach

1. MEP/FP System selections have been influenced by the following assumptions, aims, and issues:

   a. To provide a suitable and comfortable environment for students, teachers, and staff.

   b. To translate the above into cost-effective construction of reliable systems that can be easily maintained.

   c. To use minimum energy while maintaining these aims.

   d. To minimize rooftop equipment both for aesthetics and to allow for future PV installation.

   e. To provide systems which are familiar to maintenance staff while respecting the above design goals.

2. As a result, efficient, environmentally friendly, and cost-conscious systems will be realized.

C. Specific Sustainable Systems Proposed

1. Boilers - specify high efficiency condensing boilers (Options 1 and 2)

2. Hot Water Heaters - specify high efficiency condensing units (Options 1 and 2)

3. Chiller – specify high efficiency magnetic bearing unit with excellent part load efficiency, low sound operation, and low maintenance. (Options 1 and 2)

4. Variable Refrigerant Flow (Option 3)

5. Air Handling Units with Energy Recovery – utilize recirculating and 100% outside air handlers to heat, cool and dehumidify the building fresh air before it is supplied to the space. DOAS also ensures accurate outside air volumes are delivered. Capture waste heat and cooling from building exhaust systems by specifying air handlers with energy recovery wheels and reheat wheels.

6. Displacement Ventilation – utilize low velocity / low level air supply to reduce total airflow rates, increase ventilation effectiveness, improve indoor air quality, and reduce air noise. (Option 2)

7. Demand Control Ventilation – adjust outside air intake flow rates by measuring indoor CO2 levels in occupied spaces.

8. High Efficiency Filters – specify 85% to 90% filters (MERV 13) in central air handlers to improve indoor air quality.

9. Variable Speed Drives – provide for all major equipment.

10. Premium Efficiency Motors – specify premium efficiency motors for large HVAC pumps and fans.

11. ECM Motors – specify electrically commutated motors (ECM's) for smaller HVAC pumps and fans.

12. LED Lighting – specify LED lighting to reduce energy consumption.

13. Low Flow Plumbing Fixtures – utilize low flow toilets, faucets, and shower fixtures to reduce potable water consumption and heating hot water system energy use.

III. HVAC SYSTEMS

A. Codes and Standards:

1. 780 CMR – Massachusetts State Building Code, 9th Edition
2. 2015 International Building Code
3. 2015 International Mechanical Code

4. ASHRAE 90.1-2013 / IECC 2015 with MA Stretch Code Amendments. *Note: IECC 2018 with MA Amendments to be issued 2020.*
5. All state and local zoning and building laws and regulations.
6. All applicable local codes, amendments and ordinances.
7. Applicability of Standards: United States of America National Construction Industry standards will be used as a minimum except where more stringent requirements are included in the Design Criteria. Latest edition of each standard will apply.
    a. Air Moving and Conditioning Association (AMCA)
    b. American National Standard Institute (ANSI)
    c. Air Conditioning and Refrigeration Institute (ARI)
    d. American Society of. Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    e. American Society of Mechanical Engineers (ASME)
    f. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
    g. Thermal Insulation Manufacturers Association (TIMA)
    h. U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) for Schools V4
    i. National Fire Protection Association (NFPA)
    j. Underwriters Laboratories (UL)

B. Design Criteria

1. Outdoor Design Conditions:

    Summer: 90°F DB, 73°F WB
    Winter: 0°F DB

2. Indoor Design Conditions - the building will be fully air-conditioned:
    a. Classrooms: 75° F +/- 2°F; less than 55% RH
    b. Common Spaces: 75° F +/- 2°F; less than 55% RH
    c. Office Spaces: 75° F +/- 2°F; less than 55% RH
    d. Electrical Rooms: 85° F +/- 10°F
    e. IDF Rooms: 75° F +/- 2°F; no humidity control
    f. Mech. Rooms: Ventilation only, for 10°F rise above ambient
3. Air Filtration
    a. Occupied areas: MERV 8 (30-35%) & MERV 13 (85 - 90%) filters for units treating outside air.
    b. Mechanical rooms: MERV 8 (30-35%) filters.
4. Mechanical Ventilation:
    a. Fresh Air – 30% greater than ASHRAE 62.1-2010. All occupied areas will be designed to maintain 800 PPM carbon dioxide maximum through use of demand controlled ventilation.

b. Exhaust Rates:
   1) Bathrooms: 75-cfm per toilet fixture, continuous
   2) Janitor, Trash, Recycle: 15 ACH, continuous

5. Duct Sizing Criteria:
   a. Pressure Drop (max):
      1) Medium Pressure Systems – 0.2" w.c. per 100-ft
      2) Low Pressure Systems – 0.06" w.c. per 100-ft
   b. Velocity:
      1) Medium Pressure Systems – 2000-fpm max
      2) Low Pressure Systems – 1700-fpm max
      3) Low Pressure Systems (within classrooms) – 750-fpm max
6. Building Pressurization:
   a. Corridors: Positive
   b. Classrooms: Neutral
   c. Toilet/Trash/Janitor: Negative
7. Acoustics: spaces to meet the following Noise Criteria (NC) pending acoustical consultant's review:
   a. Classrooms: NC 30
   b. Meeting Rooms: NC 30
   c. Offices: NC 40
   d. Corridors: NC 45
8. LEED Requirements: refer to LEED NC for Schools V4 MEP Requirements and LEED Scorecard

C. HVAC Option 1 – Chilled and Hot Water Plants with standard VAV Air Handlers

1. Central Heating Plant
   a. The central heating plant shall be located in the main mechanical room on the first floor. The central boiler plant shall serve the heating needs for the entire building, including outside air pre-heat at the main air handling units.
   b. Three (3) 2,500-MBH gas-fired, high efficiency condensing hot water boilers shall be provided. The boilers shall be of a fire-tube design, manufactured from high grade stainless steel. Design hot water supply temperature shall be 160°F. Hot water supply temperature shall be reset downward inversely to outside air temperature.
   c. The hot water plant shall include two (2) 400-gpm, 25-hp main hot water distribution pumps with variable frequency drives (VFD's), inline pumps for each boiler, air separator, expansion tank, and water treatment system. Flues for the boilers shall terminate above the roof of the main building.
   d. VFD driven pumps shall be provided with shaft grounding rings to minimize stray currents that can damage motor bearings.

2. Central Cooling Plant
    a. The central cooling plant shall serve the chilled water needs for the entire building, which shall be fully air-conditioned.
    b. Provide one (1) 275-ton high efficiency air-cooled chiller utilizing variable speed magnetic bearing centrifugal compressors. Efficiency shall meet or exceed 0.97 KW/ton at full load and 0.50 KW/ton part load IPLV. The chiller shall be located at grade.
    c. The chilled water system shall utilize a 15°F temperature differential. AHU coils shall be selected for temperatures of 43°F entering, 58°F leaving. Pumping shall be variable primary only.
    d. The chilled water plant shall include (2) 450-gpm, 30-hp chilled water distribution pumps with VFD's, air separator, expansion tank, and water treatment system. All equipment shall be located in the main mechanical room.
    e. VFD driven pumps shall be provided with shaft grounding rings to minimize stray currents that can damage motor bearings.
    f. All building air handlers will have air-side economizers, and thus the chiller will not be needed to operate during the winter nor require water-side economizer. The chilled water system shall therefore be designed for operation on plain water. A winter freeze protection system shall be provided for seasonal draining of the chiller and outdoor piping. Freeze protection make-up fluid shall be provided via a pumped system to a mix of 40% propylene glycol and 60% water, that draws from a minimum 50 gallon glycol tank to prevent dilution. Glycol tank and pump shall be located in the main mechanical room.
3. Hot Water Distribution
    a. Hot water distribution piping shall originate with 6-inch diameter supply and return piping from the main mechanical room.
    b. Hot water shall be distributed in a loop at the first floor level and shall serve the dedicated outside air system (DOAS) unit preheat coils, terminal heating units, and perimeter heating.
    c. Hot water shall be distributed through vertical risers to serve the perimeter heating on the upper floors.
4. Chilled Water Distribution
    a. Chilled water distribution piping shall originate with 6-inch diameter supply and return piping from the main mechanical room.
    b. Chilled water shall be distributed in a loop at the first floor level and shall serve the central station air handling unit cooling coils (DOAS and AHU).
5. Dedicated Outside Air Systems
    a. Three (3) 7500-cfm dedicated outside air system (DOAS) air handlers shall supply fresh air to the classroom and administration/office space central air handling units (AHU's). The units shall be variable volume in nature to provide the minimum ventilation required based on return air and individual room CO2 levels. The units shall also provide exhaust for all bathroom and storage spaces.
    b. Each DOAS unit shall be located indoors and be of modular or semi-custom construction, with the following features:
        1) 2" double-wall, thermal break cabinet construction, with R-13 insulation value

2) MERV 8 and MERV 13 pre-filters
3) Energy recovery wheel
4) Hot water coil with blend pump
5) Chilled water coil. Coil sized at less than 450-fpm.
6) Supply fan section with VFD
7) Exhaust fan section with VFD
8) All fans shall be direct drive with shaft grounding rings to minimize stray currents that can damage motor bearings.
9) Sensible dehumidification wheel
10) Supply and return air silencers
11) Outdoor air and exhaust air shall be ducted to louvers in perimeter walls/areaways. Sound attenuation shall be provided.
12) Supply fan, exhaust fan, and outside air intake connections shall be furnished with airflow measuring stations.

6. Central Air Handling Units & Distribution
   a. Multiple central air handling units (AHU's) shall serve the building HVAC requirements. The units shall be variable volume (VAV) in nature to provide heating and cooling as described herein, and to provide the minimum ventilation required based on return air and individual room CO2 levels. All units will provide overhead supply to standard diffusers.
   b. AHU capacities shall be as follows:
      1) AHU-1: 12,000-cfm (Admin/Offices)
      2) AHU-2: 17,000-cfm (Classrooms)
      3) AHU-3: 17,000-cfm (Classrooms)
      4) AHU-4: 17,000-cfm (Classrooms)
      5) AHU-5: 12,000-cfm (Cafeteria)
      6) AHU-6: 9,000-cfm (Gymnasium, with energy recovery)
   c. AHU-1, AHU-2, AHU-3, AHU-4: the multi-zone VAV AHU's shall be located indoors. The units shall be of modular or semi-custom construction and shall have the following features:
      1) 2" double-wall, thermal break cabinet construction, with R-13 insulation value
      2) MERV 8 and MERV 13 pre-filters
      3) Mixing box
      4) Chilled water coil. Coil sized at less than 450-fpm.
      5) Supply fan section with VFD
      6) Return fan section with VFD
      7) All fans shall be direct drive with shaft grounding rings to minimize stray currents that can damage motor bearings.
      8) Supply and return air silencers

9) Minimum outdoor air shall be ducted to the return of each AHU from their respective DOAS unit.

10) Economizer outdoor air and relief air shall be ducted to louvers in perimeter walls/areaways. Sound attenuation shall be provided.

11) The AHU's shall utilize single duct VAV boxes with reheat to serve each classroom, the corridors, and each office space. VAV box quantities shall be as follows:

- One (1) VAV box per classroom/work room
- One (1) VAV box per every two enclosed offices

12) Supply distribution shall be to louvered square ceiling diffusers. Return air shall be via a grille mounted in the ceiling.

13) Provide CO2 demand controlled ventilation to maintain less than 800-ppm CO2 concentrations in each zone.

14) Provide perimeter wall-to-wall radiant ceiling panels for heating in the classrooms and offices. Provide cabinet unit heaters in the corridors.

d. Option 1b – in lieu of the all-air VAV air handlers, provide four-pipe fan coil units in the existing building. Duct fresh air into each space with VAV box connected to its DOAS unit.

e. AHU-5, AHU-6: the cafeteria and gymnasium AHU's shall be located indoors. The units shall be of modular or semi-custom construction and shall have the following features:

1) 2" double-wall, thermal break cabinet construction, with R-13 insulation value

2) MERV 8 and MERV 13 pre-filters

3) Energy recovery wheel (AHU-5 only)

4) Mixing box

5) Air blender (AHU-4 only)

6) Hot water coil with blend pump

7) Chilled water coil. Coil sized at less than 450-fpm.

8) Supply fan section with VFD

9) Return fan section with VFD

10) All fans shall be direct drive with shaft grounding rings to minimize stray currents that can damage motor bearings.

11) Sensible dehumidification wheel

12) Supply and return air silencers

13) Outdoor air and relief air shall be ducted to louvers in perimeter walls/areaways. Sound attenuation shall be provided.

14) Supply fan, return fan, and outside air intake connections shall be furnished with airflow measuring stations.

15) Units shall be single zone VAV, variable temperature and variable volume, with exposed overhead spiral ductwork. (Note: no VAV boxes are required)

16) Provide low returns with heavy duty grilles in each space

17) Provide CO2 demand controlled ventilation to maintain less than 800-ppm CO2 concentrations in each space.

7. Kitchen Make-Up & Hood Exhaust System
   a. Provide a dedicated ventilation system for the kitchen. The make-up air handler shall be located indoors and be of modular, with the following features:
      1) MUA-1: 2,000-cfm (approximate – assumes the remainder of kitchen hood make-up air is transfer air from the cafeteria)
      2) 2" double-wall, thermal break cabinet construction, with R-13 insulation value
      3) MERV 8 and MERV 13 pre-filters
      4) Face and bypass hot water coil
      5) Supply fan section with VFD; fan shall be direct drive with shaft grounding rings to minimize stray currents that can damage motor bearings.
      6) Supply air silencer
      7) Outdoor air shall be ducted to louvers in perimeter wall/areaways. Sound attenuation shall be provided.
   b. The kitchen hood shall be provided with a UL 762 listed grease exhaust fan:
      1) KEF-1: 5,000-cfm (approximate – must be matched to grease hood)
      2) Double wall stainless steel factory built grease duct to fan termination outdoors.
      3) VFD for demand controlled ventilation
      4) Provide hood thermal and smoke monitoring system for demand control of both the exhaust fan and make-up air unit.
8. Split System DX Cooling Systems
   a. Provide 2-ton split system cooling units for the main telephone & data room and each elevator machine room.
9. Miscellaneous Heating, Ventilating, and Exhaust Systems
   a. Vestibules, entryways, and stairwells shall be heated with hot water cabinet unit heaters. Heaters shall be wall or ceiling mounted depending on architectural configuration of the spaces.
   b. Mechanical spaces, plumbing rooms, electrical rooms, and small telephone & data rooms shall be heated with hot water unit heaters with integral thermostats where necessary and shall be exhausted using the DOAS units.
   c. Trash/Recycle Rooms and Janitor's Closets shall be exhausted with a minimum of 15 air changes per hour. Ductwork shall extend to roof mounted exhaust fans. Fans shall be roof mounted up-blast centrifugal units.
   d. Each elevator hoistway shall be ventilated with a louver and smoke damper located at the top of the overrun of each elevator, per MA elevator code, 524 CMR 35.00.
   e. The emergency generator (furnished and installed by others, at grade) shall be provided with an engine exhaust flue extending from the unit enclosure up to the roof of the building.

D. HVAC Option 2 – Chilled and Hot Water Plants with VAV Displacement Ventilation AHU's

1. Central Heating Plant - *same as Option 1*

2. Central Cooling Plant - *same as Option 1*
3. Hot Water Distribution - *same as Option 1*
4. Chilled Water Distribution - *same as Option 1*
5. Dedicated Outside Air Systems - *same as Option 1*
6. Central Air Handling Units & Distribution
    a. Multiple central air handling units (AHU's) shall serve the building HVAC requirements. The units shall be variable volume in nature to provide heating and cooling as described herein, and to provide the minimum ventilation required based on return air and individual room CO2 levels.
    b. AHU capacities and types shall be as follows:
        1) AHU-1: 12,000-cfm (Admin/Offices – displacement)
        2) AHU-2: 17,000-cfm (Classrooms - displacement)
        3) AHU-3: 17,000-cfm (Classrooms - displacement)
        4) AHU-4: 17,000-cfm (Classrooms - displacement)
        5) AHU-5: 12,000-cfm (Cafeteria – overhead supply)
        6) AHU-6: 9,000-cfm (Gymnasium – overhead supply with energy recovery)
    c. AHU-1, AHU-2, AHU-3, AHU-4: the displacement system AHU's shall be located indoors. The units shall be of modular or semi-custom construction and shall have the following features:
        1) 2" double-wall, thermal break cabinet construction, with R-13 insulation value
        2) MERV 8 and MERV 13 pre-filters
        3) Mixing box with return air bypass and dampers around the chilled water coil for dehumidification.
        4) Chilled water coil. Coil sized at less than 450-fpm.
        5) Supply fan section with VFD
        6) Return fan section with VFD
        7) All fans shall be direct drive with shaft grounding rings to minimize stray currents that can damage motor bearings.
        8) Supply and return air silencers
        9) Minimum outdoor air shall be ducted to the return of each AHU from their respective DOAS unit.
        10) Economizer outdoor air and relief air shall be ducted to louvers in perimeter walls/areaways. Sound attenuation shall be provided.
        11) The AHU's shall utilize single duct VAV boxes (without reheat) to serve each classroom, the corridors, and each office space. VAV box quantities shall be as follows:
            - One (1) VAV box per classroom/work room
            - One (1) VAV box per every two enclosed offices
        12) Supply distribution shall be to low wall mounted displacement diffusers. Return air shall be via a grille mounted in the ceiling.

13) Provide CO2 demand-controlled ventilation to maintain less than 800-ppm CO2 concentrations in each zone.

14) Provide perimeter wall-to-wall radiant ceiling panels for heating in the classrooms and offices. Provide cabinet unit heaters in the corridors.

d. Option 2b – in lieu of the all-air VAV displacement air handlers, provide four-pipe fan coil units in the existing building. Duct fresh air into each space with VAV box connected to its DOAS unit.

e. AHU-5, AHU-6 - *same as Option 1*

7. Kitchen Make-Up & Hood Exhaust System - *same as Option 1*
8. Split System DX Cooling Systems - *same as Option 1*
9. Miscellaneous Heating and Ventilating Systems - *same as Option 1*

E. HVAC Option 3 – Variable Refrigerant Flow (VRF)

1. Central Heating and Cooling Plant

a. Provide a total of 275-tons of air-cooled heat recovery VRF heat pumps to serve the heating and cooling for the entire building, which shall be fully air-conditioned. The VRF heat pumps shall be capable of simultaneous heating and cooling.

b. The outdoor units shall be located on the roof. To reduce the refrigerant piping quantities, it is envisioned that approximately (18) 16-ton modules will be utilized.

c. Branch circuit / zone controllers shall be located in the mechanical rooms, storage rooms, and above corridor ceilings. Main refrigerant piping shall be installed between each heat pump module and zone controller. From each zone controller, refrigerant piping shall be piped to each DOAS unit, AHU, and VRF fan coil.

2. Dedicated Outside Air Systems

a. Three (3) 7500-cfm dedicated outside air system (DOAS) air handlers shall supply fresh air directly to the classroom and administration/office spaces via VAV boxes. The units shall be variable volume in nature to provide the minimum ventilation required based on return air and individual room CO2 levels. The units shall also provide exhaust for all bathroom and storage spaces.

b. Each DOAS unit shall be located indoors and be of modular or semi-custom construction, with the following features:

1) 2” double-wall, thermal break cabinet construction, with R-13 insulation value

2) MERV 8 and MERV 13 pre-filters

3) Energy recovery wheel

4) Custom refrigerant cooling and heating coil, supplied by the VRF manufacturer and piped to the VRF system BC-controller.

5) Supply fan section with VFD

6) Exhaust fan section with VFD

7) All fans shall be direct drive with shaft grounding rings to minimize stray currents that can damage motor bearings.

8) Custom hot gas reheat coil supplied by the VRF manufacturer and piped to the VRF system BC-controller.

9) Supply and return air silencers

10) Outdoor air and exhaust air shall be ducted to louvers in perimeter walls/areaways. Sound attenuation shall be provided.

11) Supply fan, exhaust fan, and outside air intake connections shall be furnished with airflow measuring stations.

12) The DOAS units shall utilize single duct VAV boxes (without reheat) to supply fresh air directly each classroom, the corridors, and each office space. VAV box quantities shall be as follows:

- One (1) VAV box per classroom/work room
- One (1) VAV box per every four enclosed offices
- One (1) VAV box for each corridor wing

3. VRF Fan Coil Units

a. Each classroom shall be provided with a horizontal ducted VRF fan coil unit located in the adjacent corridor space, typically 1000-cfm grades 1 thru 5 and 1400-cfm for Kindergarten. The fan coil supply and return ductwork shall be provided with hospital grade non-fibrous liner. Acoustics shall target NC-30. Provide multiple 4-way blow louvered diffusers and one return grille in each classroom.

b. Each office shall be provided with a wall or floor mounted VRF fan coil unit.

c. Each corridor shall be provided with a horizontal ducted VRF fan coil.

d. Provide condensate drain piping for fan coil, for disposal at a central storm water receptor (by the plumbing contractor).

e. Provide drain pan overflow switch in each fan coil to prevent water damage from a clogged drain pan.

4. Central Air Handling Units & Distribution

a. Central air handling units (AHU's) shall serve the portions of the building not served by the VRF fan coil units. The AHU's shall be variable volume in nature to provide heating and cooling as described herein, and to provide the minimum ventilation required based on return air and individual room CO2 levels.

b. AHU capacities and types shall be as follows:

1) AHU-1: 12,000-cfm (Cafeteria – overhead supply)

2) AHU-2: 9,000-cfm (Gymnasium – overhead supply with energy recovery)

c. AHU-1, AHU-2: the cafeteria and gymnasium AHU's shall be located indoors. The units shall be of modular or semi-custom construction and shall have the following features:

1) 2" double-wall, thermal break cabinet construction, with R-13 insulation value

2) MERV 8 and MERV 13 pre-filters

3) Energy recovery wheel (AHU-5 only)

4) Mixing box

5) Custom refrigerant cooling and heating coil, supplied by the VRF manufacturer and piped to the VRF system BC-controller.

6) Supply fan section with VFD

7) Return fan section with VFD

8) All fans shall be direct drive with shaft grounding rings to minimize stray currents that can damage motor bearings.
9) Custom hot gas reheat coil supplied by the VRF manufacturer and piped to the VRF system BC-controller.
10) Supply and return air silencers
11) Outdoor air and relief air shall be ducted to louvers in perimeter walls/areaways. Sound attenuation shall be provided.
12) Supply fan, return fan, and outside air intake connections shall be furnished with airflow measuring stations.
13) Units shall be single zone VAV, variable temperature and variable volume, with exposed overhead spiral ductwork. (Note: no VAV boxes are required)
14) Provide low returns with heavy duty grilles in each space
15) Provide CO2 demand controlled ventilation to maintain less than 800-ppm CO2 concentrations in each space.

5. Kitchen Make-Up & Hood Exhaust System
   a. Provide a dedicated ventilation system for the kitchen. The make-up air handler shall be located indoors and be of modular, with the following features:
      1) MUA-1: 2,000-cfm (approximate – assumes the remainder of kitchen hood make-up air is transfer air from the cafeteria)
      2) 2” double-wall, thermal break cabinet construction, with R-13 insulation value
      3) MERV 8 and MERV 13 pre-filters
      4) Custom refrigerant heating coil, supplied by the VRF manufacturer and piped to the VRF system BC-controller.
      5) Supply fan section with VFD; fan shall be direct drive with shaft grounding rings to minimize stray currents that can damage motor bearings.
      6) Supply air silencer
      7) Outdoor air shall be ducted to louvers in perimeter wall/areaways. Sound attenuation shall be provided.
   b. The kitchen hood shall be provided with a UL 762 listed grease exhaust fan:
      1) KEF-1: 5,000-cfm (approximate – must be matched to grease hood)
      2) Double wall stainless steel factory built grease duct to fan termination outdoors.
      3) VFD for demand controlled ventilation
      4) Provide hood thermal and smoke monitoring system for demand control of both the exhaust fan and make-up air unit.
6. VRF Split System DX Cooling Systems
   a. Provide 2-ton VRF cooling units for the main telephone & data room and each elevator machine room.
7. Miscellaneous Electric Heating, Ventilating, and Exhaust Systems
   a. Vestibules, entryways, and stairwells shall be heated with electric cabinet unit heaters. Heaters shall be wall or ceiling mounted depending on architectural configuration of the spaces.

b. Mechanical spaces, plumbing rooms, electrical rooms, and small telephone & data rooms shall be heated with electric unit heaters with integral thermostats where necessary and shall be exhausted using the DOAS units.

c. Trash/Recycle Rooms and Janitor's Closets shall be exhausted with a minimum of 15 air changes per hour. Ductwork shall extend to roof mounted exhaust fans. Fans shall be roof mounted up-blast centrifugal units.

d. Each elevator hoistway shall be ventilated with a louver and smoke damper located at the top of the overrun of each elevator, per MA elevator code, 524 CMR 35.00.

e. The emergency generator (furnished and installed by others, at grade) shall be provided with an engine exhaust flue extending from the unit enclosure up to the roof of the building.

F. HVAC Balancing, Adjusting, Testing, Cleaning, and Welding

1. All HVAC systems (hydronic, air) shall be balanced by the TAB subcontractor. All testing shall be in accordance with NEBB or AABC National Standards. A written report shall be submitted for review.
2. All HVAC systems shall be tested and found tight. Any leaks developed shall be corrected prior to Owner's acceptance of the new systems.
3. All strainers and filters shall be cleaned and all systems blown free of dirt and other accumulation.
4. All welding shall be performed in accordance with ANSI Standard Code for Pressure Piping, Section I and applicable portions of ASME Boiler and Pressure Vessel Code, Section I.

G. HVAC Commissioning

1. This project shall be completely commissioned with the participation of the following parties:
   a. Owner Representative
   b. Commissioning Agent
   c. Construction Manager
   d. HVAC Contractor
   e. T&B Subcontractor
   f. ATC Subcontractor

H. Automatic Temperature Controls:

1. A direct digital control building management system (BMS) shall be provided for monitoring, scheduling and controlling all building HVAC equipment, including but limited to the central plant HVAC equipment, air handlers, exhaust systems, and terminal units.
2. System shall be native BACnet with web-based interface.
3. BACnet interface shall be provided for major standalone units including the chiller and boilers.
4. The control system shall consist of all thermostats, temperature transmitters, controllers, automatic valves and dampers, damper operators, switches, control panels, and other accessory equipment along with a complete system of electrical

wiring to fill the intent of the specification and provide for a complete and operable system. All control equipment shall be proportioning, except as noted otherwise.

5. Provide all interlocking wiring.
6. Provide all thermostats, humidistats, CO2 sensors, and interlocking wiring to all terminal equipment.

I. HVAC Outline Specifications:

1. Piping
   a. Chilled water, hot water, and vent piping shall be Schedule 40, ASTM A53 with screwed fittings up to 2" size and welded for sizes 2 1/2" and up, A106, Schedule 40. Copper will be allowed as an alternate to steel, provided dielectric unions are installed between dissimilar metals.
   b. All drain piping shall be copper Type "L", 95/5 solder.
   c. For water piping, Pro-Press (copper) couplings are allowed. Welded piping or Victaulic couplings only above 3".
   d. Make proper provisions for expansion and contraction in all parts of piping systems wherever possible by means of pipe bends, pipe offsets, swing connections or changes in direction of piping. Where piping network cannot be employed to absorb expansion and contraction in the piping systems, provide expansion joints. Provide anchors and guides as required to direct expansion towards loops or joints.
2. Chemical Treatment
   a. The services of reputable Water Treatment Contractor shall be provided to install a complete water treatment service, designed to minimize corrosion and scale formation in the chilled water and hot water systems. This service shall be provided for a period of one (1) year following the initial start-up of the systems, as well as chemicals and service for initial start-up and system cleaning.
   b. All equipment such as panels, pumps, meters solenoid valves, bleed-off valves, chemical drains, etc., shall be provided by the Chemical Treatment Contractor.
3. Sheetmetal Ductwork
   a. All sheetmetal shall be G90 galvanized steel and shall be stiffened by cross breaking and by use of galvanized rolled steel angles as required by SMACNA for its respective static pressure class.
   b. Medium pressure supply ductwork shall be SMACNA 6" w.g. pressure rated.
   c. Low pressure ductwork shall be SMACNA 2" w.g. pressure rated.
   d. All ductwork shall be 24 gauge or heavier.
   e. Pressure test all medium pressure ductwork and low pressure ductwork risers.
4. Chimneys and Stacks (Gas-fired Boilers and Water Heaters)
   a. The breeching and stacks for the hot water boilers and domestic hot water heaters shall be factory built Category IV double wall vent pipes (AL29-4C stainless steel inner wall and 304 stainless steel outer wall) with 1" air space.
   b. When connected to gas-burning appliances with a maximum continuous flue-gas temperature of 550 deg F, flue shall be capable of being fully enclosed vertically by combustible materials at 1" clearance to combustibles. The vents shall comply with UL 1738.

c. All units shall be closed combustion with ducted PVC or galvanized steel intakes.

5. Chimneys and Stacks (Diesel Generator)
   a. The flue stack for the generator shall be factory built pressure rated UL 103 chimney piping, 2" double wall with 304 stainless steel inner pipe and 304 stainless steel outer shell. Flue system shall be rated to exhaust temperatures up to 1400°F.
   b. Provide with explosion relief valve, bellows expansion joints, anchor base plate, and wall guides. Terminate stack three (3) feet above the facility roof.
6. Insulation
   a. Duct Insulation: all interior supply ductwork and concealed return ductwork shall be insulated with 2" thick, 1.0 pound per cubic foot fiberglass wrap. In addition, ductwork in mechanical rooms shall be insulated with 2" thick fiberglass board. All exterior ductwork shall be insulated with 3" thick fiberglass board with EPDM jacket.
   b. Pipe Insulation:
      1) Utilize ASJ glass fiber insulation in molded sections. Glass fiber insulation shall have minimum density of 3¼ pounds per cubic foot with a thermal conductivity ("K" value) of 0.23 at 75°F mean temperature.
      2) Chilled water piping 1-1/2" and smaller shall be provided with 1" thick insulation. Chilled water piping 2" and larger shall be provided with 1-1/2" thick insulation. Exterior piping to the chiller shall be weather jacketed and heat traced.
      3) Hot water piping 1-1/2" and smaller shall be provided with 1-1/2" thick insulation. Hot water piping 2" and larger shall be provided with 2" thick insulation.
      4) Condensate drain piping shall be provided with 1" thick insulation.
7. Vibration Isolation
   a. Noise and vibration isolation systems shall be provided to prevent the transmission of excessive structure borne noise or vibration to critical and non-critical areas of the building as characterized by noise criteria levels.
   b. All pumps, fans, air handling units and the chiller shall be equipped with vibration isolation springs and all piping within the mechanical rooms shall be hung with hangers equipped with spring vibration isolators.
   c. All pumps shall be installed on inertia bases and piping shall have flexible hose connections.
8. Submittals
   a. Provide testing and documentation in accordance with project requirements for LEED submission to achieve the target score indicated in NC for Schools V4 MEP REQUIREMENTS and LEED Scorecard.
   b. Submit for approval product data for all HVAC and Automatic Temperature Control equipment.
   c. Submit coordination drawings (1/4" scale), electronic and hardcopy, for review. The HVAC subcontractor shall compare his specifications and any drawings with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the HVAC work. All work

shall be installed in cooperation with other Trades installing interrelated work. Before installation, This Subcontractor shall make proper provisions to avoid interference in a manner approved by the Architect. All changes required in the HVAC work caused by this Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction. This Subcontractor must include in his bid sufficient dollar amounts to coordinate the work of this Contract. This project may require additional time to coordinate all Trades. This requirement shall include, but not be limited to, producing the coordination drawings, as many times and as many drawings as required, to ensure serviceability of equipment, as approved by the Owner.

d. Submit installation, operation, and maintenance manuals for all equipment and systems.

Submit record documents, including as-built drawings.

IV. ELECTRICAL SYSTEMS

A. Utility Services

1. Electrical Service (Normal Power)

a. Coordinate with Electric Company for estimated utility back charges, assume a line item allowance for cost estimating purposes.

b. Underground Secondary Electric Service - one 2000Amp, 480Y/277V, 3 phase, 4 wire secondary electric service to terminate on a metal front accessible only main switchboard with 2000amp Frame/2000amp insulated case fixed mount LSIG adjustable digital trip with zone interlocking selectivity main breaker, integral TVSS minimum 240kA, utility CT cubicle and customer digital metering display. Feeder breaker distribution sections shall be assumed to be (2) 42” square sections group mounted, front accessible rear aligned with all feeder breakers LSI optimized for zone selective interlocking with the main breaker for selectivity purposes. Switchboard shall be minimum 100KAIC, subjected to higher level based on power system studies. Unmetered tap section for Solar Photovoltaic connection provisions.

c. The electrical distribution equipment shall have integral main switchboard mounted digital metering collector to provide status on electrical power characteristics on LCD backlight display and remote output data to the data acquisition metering system.

2. Telecommunication Service

a. Assume the utility companies’ telecommunications service to originate from their service connection point at the street. Provide (3) 4” conduits routed to the building’s main telecommunication equipment room.

B. Normal Power Distribution System

1. Each electric room will house panelboards, dry-type transformers lighting control panels, sub-metering equipment, fire alarm terminal cabinets and battery cabinets.

2. Normal /optional standby/ panelboards shall be copper bus with door in door type trims, molded case circuit breaker types.

3. Refer to HVAC, Plumbing, Fire Protection, Architectural, Civil documentation for equipment requiring electrical power.

4. A power system and short circuit study for the complete electrical system distribution equipment will be a submittal item and included in the O&M manuals.

C. Generator Power Distribution System

1. An exterior mounted, self-contained factory level 2 sound attenuated weatherproof non-walk in enclosure, 100kW, 480Y/277V, 3 phase, 4 wire engine generator.

2. Provide radiator mount load bank for automatic load test NFPA 110 with regenerative power absorption features. Assume to extend exhaust stack 10’ above the generator exhaust.

3. Coordinate with the Architect and the Acoustical Sound Consultant for exterior wall acoustical treatment with enough height above the generator roof enclosure to block off and attenuate acoustical noise to the property line to meet Town of Westborough sound ordinance purposes. Recommend that a cost line item to be identified for such treatment.

4. Coordinate with the Architect and the Environmental Air Pollution Consultant for any further diesel engine generator silencer exhaust emissions treatment required. Coordinate with HVAC for exhaust stack requirements. Recommend that a cost line item to be identified for such treatment.

5. Automatic transfer switch shall be 100KAIC@480V for withstand and closing rating.

6. Assume the following building loads will be desired to be on optional standby power backup in event of a prolonged utility power failure. (Assume 150amp due to withstand and closing interrupting short circuit rating).

   a. Kitchen walk-in coolers and freezers.

   b. Central heating plant – boilers, circulator pumps, controls, boiler room motorized dampers.

   c. Main administration office receptacle loads.

   d. Telecommunications rooms power and small cooling loads serving those rooms.

   e. Security and access control system.

   f. Paging/Intercom System

   g. Telephone System

   h. Network servers and switches

   i. Central Clock System

   j. Local AV systems

D. Sustainable Design Intent LEED

1. Sustainable Design Intent compliance will include:

    a. Advanced measurement and verification of HVAC, lighting, receptacle power via electronic sub-meters equal to E-Mon Class 5000 3-phase kWh and demand meters. Measurement and verification metering will be monitored by the Building Management System (BMS).

    b. Advanced lighting controls include a low voltage lighting control system with time schedule control for common areas, vacancy/occupancy sensors and photocells for daylight harvesting.

    c. Switchboard will consists of a unmetered tap section for the solar photovoltaic (PV) system tie in.

    d. Light pollution reduction for exterior lighting through the use of full cutoff and low glare luminaires.

E. Lighting Systems and Controls

1. Energy efficient fixtures and lighting controls to exceed code requirements to meet utility company's eligible rebate incentive programs where applicable.

2. All LED lighting fixtures shall be Design Lights Consortium certified.

3. Recess LED down lights shall be Energy Star certified.

4. LED lamp modules shall comply with IES LM-79 and LM-80 requirements with minimum color rendering index (CRI) 82 with minimum rated life of 50,000 hours per IES L70.

5. Color temperature shift shall comply with ANSI C78 377A for LED binning with further sub-binning restrictions of chromatic to be at or below the visual threshold of perceivable color variation not exceeding the 3 step MacAdam Ellipse line that crosses the black body locus as indicated on the LM79 report. Such restrictions documentation compliance shall be submitted as part of the submittal process.

    a. Classrooms, Art rooms, Library, Main Office provide automatic shut-off occupancy sensor dual technology PIR ultrasonic type with relay packs and manual downstream wall mounted on/off switches by entry door to control lights by rows. Classrooms/Art rooms with perimeter window day light possibility shall have fixture mounted photo sensor for group dimming per row parallel with perimeter windows. The photocell sensor allow automatic preset dimming functions as well as wall controls to allow for manual over-ride lighting level adjustments and on/off features as well.

    b. Common corridors and other open areas to be switched by lighting control relay panel system with low voltage switches with photocell and time clock inputs to provide means of automatic control the building interior and site lighting to reduce energy costs.

    c. All LED exit fixtures and selected lighting fixtures in egress pathways shall be wired to the emergency battery lighting inverter system.

d. Emergency battery lighting inverter system shall consists of compact centralized emergency lighting inverters. Use Controlled Power Company UltraLITE Model ELU or approved equal.

F. Branch Circuitry

1. Assume Type MC Cable THHN/THWN 600V in concealed areas for 20amp branch circuitry for lighting and wiring devices, use EMT conduit for exposed areas and where Type MC is prohibited by Code.

2. Assume RGS conduit for exterior exposed, under slab and 5’ from footings, with XHHW-2 600V wiring.

3. PVC SCH 40 underground, and copper wiring with 600V THHN/THWN insulation for branch circuits, 600V XHHW-2 insulation for feeders.

4. All conductors to be copper.

G. Fire Alarm System

1. Fire alarm system shall be an addressable fire alarm general voice evacuation system that complies with 780CMR and NFPA 72 requirements. The system shall include, but not limited to: Fire Alarm Control Panel, digital dialer, rotating beacon, remote annunciator panel with one-way microphone, double-action manual pull stations with Stopper Covers, photoelectric smoke detectors, fix-temp/rate-of-rise heat detectors, monitoring of building fire protection system flow, tamper and pressure switches, kitchen ANSUL systems, duct smoke detection, notification appliances, etc.

2. The fire alarm system will be monitored by a central station via cellular and UDACT dial out for alarm, supervisory and trouble conditions.

3. Fire alarm remote annunciator panel with microphone pickup and paging zones at the building main entry designated location as approved by the local Fire Department.

4. Manual pull stations will be located within 5’ of all egress doors and at the stairwell entrances to each floor.

5. Fire alarm notification appliances shall be combination type adjustable watt tap speaker/ADA strobes located throughout all areas including, but not limited to; common corridors, mechanical rooms, classrooms, art rooms, cafetorium, gym, kitchen and other similar public spaces. Audibility and intelligibility of voice evacuation will require denser spacing of speakers and lower watt tap settings in large open areas. Assume corridor and public areas speaker/ADA strobes at 30’ spacing, every classroom to have one speaker/ADA strobe.

6. System type smoke detectors will be provided throughout all corridors, stairwells, elevator machine room and lobbies, electric rooms and telecommunication rooms for early warning purposes. Heat detectors shall be provided in janitor’s closets and mechanical rooms to avoid nuisance alarms. All electrical and communication rooms will have smoke detector remote indicator outside the door.

7. Duct smoke detection systems will be provided for HVAC air handling units producing greater than 2000cfm on the supply and return side. System shall consist of system type photoelectric smoke detector and duct housing, equipment shut-down relay, sampling tube and key switched remote test station.

8. The fire alarm system will monitor the pull stations, smoke detectors, heat detectors, sprinkler system flow and tamper switches and duct smoke detectors. Signaling line circuits shall be Class 'A' and the notification appliance circuits shall be Class 'A'.

9. The activation of a manual pull station or an initiating device will activate the building fire alarm notification devices and will transmit an addressable "alarm" signal to the fire alarm control panel and annunciator panel.

10. The system shall be provided with a battery back-up rated for a minimum of 24 hours stand-by and 15 minutes alarm backup capacity.

11. Key repository box will be provided at both the fire department primary and secondary building entrances.

H. Emergency Responder Radio System

1. An Emergency Responder Radio Coverage system will be provided in compliance with Massachusetts 780 CMR 916 requirements, NFPA 72 requirements, and local Emergency Responders requirements.

I. Wiring Devices and Specific Programming Needs

1. Refer to architectural programming/user group documentation for any specific wiring devices requirements. If such information is not available or limited, assume the following to supplement the design criteria

2. In all classrooms and special resource rooms, assume duplex receptacle wiring device every 12' on blank walls. Teacher's desk location should have double duplex receptacle wiring devices.

3. Coordinate with Architect if Classrooms/Art rooms will have computer PC workstation and smart board. If so, provide power, data, and A/V at each PC workstation and smart board.

4. For offices, guidance, counseling rooms, assume double duplex receptacle at desk location and one duplex receptacle on the other walls. Assume dedicated circuits for copiers, laser printers and similar office printing equipment.

5. In main Office, teacher's/staff room, library provide duplex receptacles at work stations plus dedicated duplex receptacles for copiers and laser printer locations.

6. One (1) duplex receptacle every 50' along corridors, gym, cafetorium, auditorium and other open areas.

7. Assume convenience GFCI duplex receptacle in restrooms, janitorial, mechanical and electrical rooms, and where located within 6' from a sink.

8. All non-locking type 125V, 15A and 20A receptacles shall be listed tamper-resistant.

J. Lightning Protection System

1. Provide a complete design build UL Master Label Lightning Protection (traditional lightning rods) System with interior concealed down leads and grounding with bonding to main electric service grounding.

K. Solar Photovoltaic (PV) Systems

1. Refer to Architectural program information and the Solar PV Consultant for future design build solar photovoltaic (PV) system. Electrical shall allow for provisions for future PV system interface.

L. Electric Vehicle Charging Stations

1. Provide 20% of total parking space, dual-port electric vehicle charging stations in the parking lot. Use Chargeport+ CT 4021 Bollard or equal.

V. PLUMBING SYSTEMS

A. Codes and Standards:

1. 780 CMR – Massachusetts State Building Code, 9th Edition
2. 248 CMR - Massachusetts State Plumbing Code
3. Massachusetts Fuel Gas Code
4. National Fire Protection Association (NFPA)
5. All state and local zoning and building laws and regulations.
6. All applicable local codes, amendments and ordinances.
7. Applicability of Standards: United States of America National Construction Industry standards will be used as a minimum except where more stringent requirements are included in the Design Criteria. Latest edition of each standard will apply.
    a. Underwriters Laboratories (UL)
    b. American National Standard Institute (ANSI)
    c. American Society of Mechanical Engineers (ASME)
    d. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

B. General

1. All piping, fittings, valves, fixtures, supplies and stops, meters, outlets etc. shall be compliant with the “Reduction of Lead in Drinking Water Act”; NSF 61 section 9 compliant.
2. Kitchen staff shall have their own restrooms per code.
3. Teachers/staff and students shall have independent restrooms per code.

C. Water

1. A new 4" cement lined ductile iron water service shall be brought into the new water service room. A new water meter will be provided per the Groton Water standards and installation requirements.

2. Distribution main in the building shall be a 4" CW.

3. A reduced pressure backflow preventer shall isolate local hazards within the building:

   a. Commercial dishwashers
   b. Pot wash sinks
   c. Chemical dispensers
   d. HVAC makeup

4. Hot Water

   a. Primary

      1) Double wall heat exchangers, circulation pumps, storage tanks and controls.
      2) Storage tanks shall be ASME, (2) 215 gallons.
      3) HX shall be (2) 349MBH and MA approved.
      4) Heat exchanger shall be fed from the boiler hot water (for backup) or geothermal loop process hot water (Primary) under Division 23.
      5) Piping from the HVAC process loop to the HX and the tank, including the pumps and valving shall be under division 22.

   b. Secondary (backup)

      i. The heat exchangers and tanks arrangement in the "primary" hot water system above shall be supplied with process water from the back-up HVAC gas fired boiler, with independent control valves, piping and pumps under division 22

   c. New cold, hot and hot water circulation will be distributed to the fixtures requiring such. All risers shall have a shutoff and drain valves at the base. Circulation balancing valves (thermostatic type) will be located to maintain hot water within 6 feet of all sensor operated faucets.

   d. An ECMV (electronically controlled mixing valve) as manufactured by Leonard or Armstrong will provide a constant distribution temperature out to the building of 130°F.

   e. Local mixing valves at the sinks/faucets will limit hot water temperature to 110°F.

   f. Hot water circulation shall be accomplished with VFD circulation pumps with the control based on pressure, balancing valves shall be circuit solver thermostatically controlled balancing valves (flow based on temperature).

   g. 140°F hot water supply in the kitchen shall be accomplished via an independent 140°F hot water supply and circulation system.

5. Shutoff valves will be provided on the riser takeoffs on each floor for isolation.

6. All fixture batteries will be provided with water hammer arrestors.

7. Piping

    a. Type L copper with roll groove connections 2-1/2" and larger, propress connections 2" and smaller. Can also be sweat connections where more cost effective.

D. Sanitary, Waste and Vent

1. Sanitary, waste and vent will be piped at each toilet/bathroom group, kitchen, break room sink and classroom sink. Each stack will be independently vented through the roof, vent terminations will be 25ft or more from fresh air intakes and building openings.

2. New stacks will be piped down through the building, offsetting below the 1st floor slab with new horizontal below slab piping out to 10ft beyond the inside of the foundation wall.

3. Sewage ejectors will be located in the elevator pits on the first floor and will discharge though an oil separator prior to connecting to the building sanitary drainage system.

4. Kitchen Waste and Vent

    a. The kitchen will require local grease traps to serve fixtures and floor drains:

        i. Pot sink (dedicated grease trap in the floor)
        ii. Floor drains and floor sinks (to a below the floor grease trap)
        iii. Dishwashers (indirect waste to a floor sink)
        Garbage disposals shall not discharge to a grease trap.

    b. Central grease trap

        i. A central grease trap shall be provided for the cafeteria. Shall be vented back to the building, through the roof.

        ii. The central grease trap shall be a high efficiency manufactured unit of resin plastic.

5. Piping

    a. Will be no hub cast iron above grade, service weight cast iron below grade.

    b. Kitchen waste and vent piping shall be epoxy coated cast iron

E. Storm

1. New storm stacks will be piped from each new roof drain down through the building, offsetting below the slab with new horizontal below slab piping out to 10ft beyond the inside of the foundation wall.

2. Emergency roof drainage will be accomplished via weirs in the parapet that allow the ponding water on the roof to overflow the edge should the primary roof drainage

become blocked. The front portion of the roof shall be piped via independent overflow roof drains, that discharge 18" above grade.

3. Gutters and downspouts (under miscellaneous metals) will be provided with downspout boots and be piped to the site storm drainage system.

4. Piping

    a. Will be no hub cast iron above grade and service weight cast iron below grade. Horizontal storm piping will be insulated to prevent condensation.

F. Gas

1. A new gas service shall be run to the building and piping shall be distributed to the gas fired HVAC equipment (backup boiler) and the kitchen equipment.

2. Piping

    a. Will be schedule 40 black steel with mega press connections 2" and smaller, welded connections 2-1/2" and larger.

G. Plumbing Fixtures

1. All plumbing fixtures shall be High Efficiency Type (HET) water conserving, lead free fixtures that meet accessibility requirements and safe drinking water standards. The architect and the owner shall make the selection of fixtures and accessories.

2. All fixtures must be MA State Plumbing Board approved.

    a. Water closets

        1) Sensor operated flush valves. Dual flush 1.6/1.1 GPF

    b. Lavatories

        1) Sensor type, 0.19 GPC, 10s cycle

    c. Kitchen Sinks

        1) 1.5 GPM

    d. Janitor's closets

        1) 2.5 GPM faucet

    e. Emergency eye/face washes

        1) Shall be provided with tempered water and a remote strobe/horn activated upon water flow.

        2) The mechanical room as well as each janitor's closet shall have an emergency eye/face wash.

    f. Frost proof hose bibs shall be located at grade through the façade adjacent entry ways.

g. All trash rooms, mechanical rooms, common area toilet rooms, loading docks etc. shall be provided with hose bibs.

H. Drainage Specialties

1. General floor drains shall be cast iron body and nickel bronze strainer, heel proof grate. Jay R. Smith, Zurn or Josam.

2. Mechanical room floor drains shall be cast iron body and nickel bronze strainer, loose set tractor grate and sediment bucket. Jay R. Smith, Zurn or Josam.

3. Roof drains shall be cast iron body with nickel bronze dome strainer. Overflow shall be the same, with standpipe set to a height determined by structural for the allowable roof ponding.

4. Kitchen areas shall have 316 stainless steel floor drains with stainless steel strainer. Partial grate for receiving indirect waste.

5. Floor drains shall be located in all mechanical rooms near water based system equipment, at backflow preventers, water meters, trash rooms, etc

6. All common area bathrooms shall have a floor drain and hose bib.

7. Cleanouts

a. Floor cleanouts shall consist of dura-coated cast iron body, no hub or speed set outlet, tapered threaded plug, adjustable nickel bronze top, J.R. Smith, Zurn, Josam or Watts.

b. Tile or carpet recess as required for floor finish.

I. Insulation:

1. Insulation shall be as follows:

a. Hot water and hot water circulation piping (105^{o}F – 140^{o}F):

1) Pipe size less than 1 ½": insulation shall be 1" thick (R3.7) and have a thermal conductivity not exceeding 0.27 Btu per inch/hr · ft2 ·°F.

2) Pipe size 1 ½" and greater: insulation shall be 1 ½" thick and have a thermal conductivity not exceeding 0.27 Btu per inch/hr · ft2 ·°F. (R 5.5)

3) All 140oF hot water and hot water circulation piping shall be insulated with 1 ½" thick insulation that has a thermal conductivity not exceeding 0.27 Btu per inch/hr · ft2 ·°F. (R 5.5)

b. Cold water piping: insulation shall be 1" thick and have a thermal conductivity not exceeding 0.27 Btu per inch/hr · ft2 ·°F.

c. Horizontal storm water conductors and clear water waste piping: insulation shall be 1" thick and have a thermal conductivity not exceeding 0.27 Btu per inch/hr · ft2 ·°F. Where the piping turns vertical within 30 feet of the drain or receptor the

vertical portion shall also be insulated down to the first penetration through the floor.

d. Piping and fittings exposed to the elements or not concealed shall have PVC jacket applied over the factory applied 8 ounce canvas finish or pre-sized glass cloth jacket.

e. All insulation and jacketing/fittings located in air plenums shall be smoke-proof and non-combustible, in compliance with the flame and smoke spread ratings of ASTM E84 (plenum rated).

J. Identification

1. The piping of each system shall be identified in the following locations and where directed by the Architect.

   a. Pipe mains and branches – every 10'-0"

   b. At each valve.

   c. Each wall penetration (both sides)

   d. Each riser including branch risers from mains.

   e. At each piece of equipment.

   f. At each change of direction

   g. Near each access panel

2. All equipment used in the plumbing systems shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

3. Each item of equipment such as pumps, water heaters, grease traps, interceptors, etc., shall be identified by a permanently attached nameplate.

4. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the Plumbing Subcontractor.

5. Provide neat circular brass valve tags of at least 1 ½" in diameter, attached with brass hook to each valve stem or handle as determined by Architect. Stamp on these valve tags, in letters as large as practical, the number of the valve and the service, such as "HW", "HWC", "CW", for hot water, hot water circulation, cold water. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation.

K. Submittals

1. Provide testing and documentation in accordance with project requirements for LEED submission to achieve the target score indicated in NC for Schools V4 MEP REQUIREMENTS and LEED Scorecard.

2. Submit coordination drawings (1/4” scale), electronic and hardcopy, for review. The subcontractor shall compare his specifications and any drawings with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, This Subcontractor shall make proper provisions to avoid interference in a manner approved by the Architect. All changes required under this division caused by this Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction. This Subcontractor must include in his bid sufficient dollar amounts to coordinate the work of this Contract. This project may require additional time to coordinate all Trades. This requirement shall include, but not be limited to, producing the coordination drawings, as many times and as many drawings as required, to ensure serviceability of equipment, as approved by the Owner.

3. Submit installation, operation, and maintenance manuals for all equipment and systems.

4. Submit record documents, including as-built drawings.

VI. FIRE PROTECTION SYSTEMS

A. Codes and Standards:

1. 780 CMR – Massachusetts State Building Code, 9th Edition

2. National Fire Protection Association (NFPA) 13, 14 and 20

3. All state and local zoning and building laws and regulations.

4. All applicable local codes, amendments and ordinances.

5. Applicability of Standards: United States of America National Construction Industry standards will be used as a minimum except where more stringent requirements are included in the Design Criteria. Latest edition of each standard will apply.

   a. Underwriters Laboratories (UL)

   b. American National Standard Institute (ANSI)

   c. American Society of Mechanical Engineers (ASME)

   d. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

B. Fire Protection

1. A new 8” cement lined ductile iron fire protection service shall be brought into the new water service room on the first floor. An isolation valve will be installed in the vertical position just above the floor slab.

2. The building will be isolated with a 6” double check valve assembly located in the water service room.

3. A new 6” riser check valve will alarm and isolate the building and allow flow testing of the service. The new sprinkler distribution to the most remote portion of the building will be 6”.

4. Storz pumper connection (up to 750 GPM) will be provided for the sprinkler system.

5. Due to the height of the building standpipes are not required.

6. A dry pipe valve will be installed to protect the loading dock.

7. All flows, tampers and pressure switches will be wired to the building fire alarm system.

8. The sprinkler system on each level will be isolated by floor with a floor control valve station and inspector’s test. The piping and valving will be enclosed in a ceiling where possible and accessed via access panels.

9. Hydrant flow test information

    1) Testing company: TBD
    2) Date: TBD
    3) Time: TBD
    4) Static: ## PSI (Hydrant elevation @ ###ft)
    5) Residual: ## PSI, flowing #### GPM (Hydrant elevation @ ###ft)

10. Piping will be as follows:

    a. Wet systems: schedule 40 black steel. Threaded 1”, roll groove 1 ¼” and larger.

    b. Dry system (loading dock, mechanical crawl space)): schedule 40 black steel. Threaded 1”, roll groove 1 ¼” and larger. Air supply shall be via a dry pack air supply with a low dew point.

11. The building shall be fully sprinklered as follows:

    a. Offices, Classrooms, Corridors, Toilet Rooms, Etc.:

        1) 0.10 GPM/ft^2 over 1500ft^2, 250GPM hose.

    b. Mechanical Rooms and Storage Areas:

        1) 0.20 GPM/ft^2 over 1500ft^2 or area of room (whichever is less), 250 GPM hose.

    c. Theater, Stage:

        1) 0.20 GPM/ft^2 over 1500ft^2 or area of room (whichever is less), 250 GPM hose.

    d. Loading dock:

        1) 0.20 GPM/ft^2 over entire area, 250 GPM hose.

e. Gymnasium
   1) 0.15 GPM/ft^2 over 1500ft^2, 250 GPM hose.

f. Sprinklers:

   1) Class Rooms, Offices, Corridors:

      a) Shall be 5.6K, quick response, standard coverage, pendants with flat, white cover plates.
      b) In areas with decorative ceilings the cover plates shall be ordered from the factory to color-match the surface.

   2) Mechanical Rooms

      a) Shall be 5.6K, quick response, standard coverage, pendants and uprights with protective cages.

   3) Kitchen

      a) Stainless steel, intermediate temperature, 5.6K, quick response, standard coverage.

   4) Gymnasium

      a) Shall be 5.6K, quick response, standard coverage, concealed pendants

12. All system test drains will be piped to grade.

13. Identification

   a. The piping of each system shall be identified in the following locations and where directed by the Architect.

      1) Pipe mains and branches – every 10’-0”

      2) At each valve.

      3) Each wall penetration (both sides)

      4) Each riser including branch risers from mains.

      5) At each piece of equipment.

      6) At each change of direction

      7) Near each access panel

   b. All equipment shall have a permanently attached nameplate identifying the manufacturer, service, size, serial number or model number, etc. The nameplates shall be kept clean and readable at all times.

   c. Each item of equipment such as compressors, dry pipe valves, main alarm valves, floor control valve stations, etc., shall be identified by a permanently attached nameplate.

d. A legend showing the service and an arrow indicating the direction of flow shall be applied on each pipe installed by the Plumbing Subcontractor.

e. Provide neat circular brass valve tags of at least 1 ½" in diameter, attached with brass hook to each valve stem or handle as determined by Architect. Stamp on these valve tags, in letters as large as practical, the number of the valve and the service, such as "SP", SPR", "DR", for STANDPIPE, SPRINKLER, DRAIN. The numbers of each service shall be consecutive. Obtain approval of Architect prior to installation.

14. Submittals

a. Provide testing and documentation in accordance with project requirements for LEED submission to achieve the target score indicated in NC for Schools V4 MEP REQUIREMENTS and LEED Scorecard.

b. Submit coordination drawings (1/4" scale), electronic and hardcopy, for review. The subcontractor shall compare his specifications and any drawings with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, This Subcontractor shall make proper provisions to avoid interference in a manner approved by the Architect. All changes required under this division caused by this Subcontractor's neglect, shall be made by him at his own expense, to the Architect's satisfaction. This Subcontractor must include in his bid sufficient dollar amounts to coordinate the work of this Contract. This project may require additional time to coordinate all Trades. This requirement shall include, but not be limited to, producing the coordination drawings, as many times and as many drawings as required, to ensure serviceability of equipment, as approved by the Owner.

c. Submit installation, operation, and maintenance manuals for all equipment and systems.


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