DOVER HIGH SCHOOL AND CAREER TECHNICAL CENTER

Appendix

Dover, New Hampshire

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Volume 3 of 3 (Continued)

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Table of Contents

Appendix A.4

Mechanical, Electrical, Plumbing, Fire Protection & Technology Cost Estimating Narratives

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47905/Page 1/May 15, 2015

HVAC SYSTEMS NARRATIVE REPORT

OPTION 1 – FULL REHABILITATION

The following is the HVAC system narrative, which defines the scope of work and capacities of the HVAC system as well as the Basis of Design. The HVAC systems shall be designed and constructed for ***LEED for Schools*** where indicated on this narrative.

1. CODES:

   All work installed under Division 230000 shall comply with the State of New Hampshire Building Code and all local, IBC 2012, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT:

   The work of Division 230000 is described within the narrative report. The HVAC project scope of work shall consist of providing new HVAC equipment and systems as described here within. All new work shall consist of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Heating, Ventilating and Air Conditioning work and all items incidental thereto, including commissioning and testing.

3. BASIS OF DESIGN:

   Project weather and Code temperature values are listed herein based on weather data values as determined from ASHRAE weather data tables and the International Energy Conservation Code.

   Outside: Winter -2 deg. F, Summer 88 deg. F DB 73 deg. F WB

   Inside: 70 deg. F +/- 2 deg F for heating, 75 deg. F +/- 2 deg F (55% RH) for cooling for areas with air conditioning, 78 deg. F +/- 2 deg. F (<60% RH) for areas with displacement/dehumidification*(see Displacement Ventilation note below). Unoccupied temperature setback will be provided (60 deg F heating (adj.), 85 deg F cooling/dehumidification (adj.).

   Outside air shall be provided at the rate in accordance with ASHRAE guide 62.1-2010 and the International Mechanical Code as a minimum. All occupied areas will be designed to maintain 800 PPM carbon dioxide maximum.

4. SYSTEM DESCRIPTION:

   A. Central Heating Plants: ***LEED for Schools Credit EP2 & EC1***

      Heating for the entire building will be through the use of a high efficiency gas-fired condensing boiler plant.

      The new boiler plant shall be provided with (4) 3,000 MBH output boilers and (2) end suction base mounted primary and standby pumps with a capacity of 800 gpm each will be located in the mechanical room. Boilers shall each be sized for approximately 33% of the building radiation heating load. In addition to new boilers and pumps, new hot water accessories including air separators and expansion tanks shall be provided.

The boiler plant will supply heating hot water to heating equipment and systems located throughout the building through a two-pipe fiberglass insulated schedule 40 black steel and copper piping system. The boiler plants shall supply a maximum hot water temperature of 160 deg F on a design heating day and the hot water supply water temperature will be adjusted downward based on an outside temperature reset schedule to improve the overall operating efficiency of the power plants. Primary and standby end suction base mounted pumps will be provided with variable frequency drives for variable volume flow through the water distribution system for improved energy efficiency.

Combustion air for each boiler will be directly ducted to each boiler through a galvanized ductwork distribution system. Venting from each boiler shall be through separate double wall aluminized stainless steel (AL29-4C) vent system and shall discharge approximately 12 feet above the roof level. Final venting height will be depending on the location of building intake air locations and adjacent roofs.

B. Central Cooling Plant: ***LEED for Schools Credit EP2 & EC1***

A high efficiency central chilled water cooling plant consisting of a 100 ton high efficiency air cooled chilled, primary and standby chilled water pumps with VFDs, each with a capacity of 210 gpm, accessories, controls and steel and copper piping distribution system shall be provided to serve chilled water cooling HVAC equipment located throughout the building. The chilled water system will consist of a 35% propylene glycol solution. A glycol make-up feed unit system shall be provided.

The chiller plant shall serve active chilled beam induction units located in the Administration, Town Square, Forum areas of the building and select classrooms that require full air conditioning.

C. Classroom Heating and Ventilation *(General Classrooms, Learning Commons, Science, Art, SPED, Cosmetology, Computer Tech/Programming, Life, Health and Family Cons Science, Pre-Engineering, ROTC)**:***
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

It is proposed that new overhead dehumidification ventilation systems are installed to serve the Building classroom areas under this Option.

New air handling units with supply and return fan with VFDs, energy recovery wheels, gas fired heating and DX cooling with modulating capacity control, sensible reheat wheel or heat pipe, and MERV 13 filtration will be provided to serve the new dehumidification ventilation system. Supply air will be provided to the space through new insulated, galvanized steel supply duct distribution system and shall be connected to ceiling-mounted ventilation diffusers located within the classrooms. Return air will be drawn back to the units by ceiling return air registers located within the classroom and will be routed back to the air handling unit by an insulated galvanized sheetmetal return air ductwork distribution system. Supplemental hot water fin tube radiation or ceiling radiant heating will be provided along exterior walls.

Each classroom will be provided with a variable air volume terminal box and CO2 sensor for demand ventilation control.

It is estimated that the following air handling equipment will be required to serve these Classroom areas:

Due to the Structural limitations of the existing building structure, rooftop unit sizes will generally have to be maintained at a maximum of 5,000 lbs. This generally equates to a rooftop unit capacity of approximately 4,000 CFM (13 tons). Therefore its is estimated that the following rooftop units shall be required to serve the Classrooms. In addition, ceiling heights will not be high enough in most classrooms to support a displacement ventilation system. Therefore, an overhead dehumidification system has been proposed.

RTU-1 thru RTU-20: Twenty (20) rooftop air handling units with a capacity of 4,000 CFM (12 tons cooling, 180 MBH heating output) each, to serve the Classroom areas.

Dehumidification Ventilation:

The dehumidification ventilation system for the classroom wings are intended to provide a maximum cooling temperature during peak cooling periods of approximately 80°F, however, the ventilation air provided will be extremely dry which will be the result of utilizing refrigeration equipment and hot gas reheat to reduce vapor pressure to an extremely low condition of approximately 52 grains of moisture per pound of air and reheating the air to a supply temperature of approximately 58°F which will be distributed to each space. The extremely dry condition of the supply air provides the perception of a condition that is cooler than is actually occurring due to the evaporation of moisture to the adjacent air from the occupants of the space.

Considering maximum cooling requirements occur primarily during the months of July and August when the majority of the academic areas are not in use, it would suggest maintaining slightly higher temperatures may not present discomfort, however, will relate to a substantial operating cost savings and a reduced installation cost.

An additional major benefit of utilizing dry air within the building will be the overall reduction of vapor pressure typically present in outside ventilation air during summer months. This reduction in vapor pressure will dramatically reduce the amount of moisture entering the building and the potential of condensation resulting in moisture, and a direct relationship with the formation of mold.

Classrooms Requiring Full Air Conditioning:

Classrooms that require full air conditioning will be provided with supplemental cooling active chilled beam induction units.

D. Gymnasium:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

AHU-21&22: The gymnasium will be served by two (2) air-handling units of the recirculation design. The unit will be approximately 6,500 CFM and will include supply and return fans with VFDs, 320 MBH output hot water heating and 22 Tons chilled water cooling with modulating capacity control, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an exposed galvanized steel supply duct with drum louvers to project the air to the floor. As levels of carbon dioxide drop generally relating to a reduction in population a variable frequency drive located in each

air-handling unit will modulate to reduce airflow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the air handling unit by a low wall return air register.

E. Alternate PE:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-23: The Alternate PE area will be served by a rooftop air-handling unit of the recirculation design. The unit will be approximately 2,500 CFM and will include supply and return fans with VFDs, 130 MBH output gas fired heating and 7.5 Ton DX cooling with modulating capacity control, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an exposed galvanized steel supply duct with drum louvers to project the air to the floor. As levels of carbon dioxide drop generally relating to a reduction in population a variable frequency drive located in each air-handling unit will modulate to reduce airflow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the air-handling unit by a low wall return air register.

F. Fitness Room:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-24: The Fitness area will be served by an air-handling unit of the recirculation design. The unit will be approximately 2,000 CFM and will include supply and return fans with VFDs, 120 MBH output gas fired eating and 6.5 Ton DX cooling with modulating capacity control, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an exposed galvanized steel supply duct with drum louvers to project the air to the floor. As levels of carbon dioxide drop generally relating to a reduction in population a variable frequency drive located in each air-handling unit will modulate to reduce airflow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the air-handling unit by a low wall return air register.

G. Locker Rooms:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-25 & RTU-26: The Boys and Girls locker rooms, and adjacent PE office areas will be provided with new roof-mounted air handling units of the 100% outside air design with energy recovery. There will be (2) units, with one unit serving the Boy's locker room areas and the other unit serving the Girl's locker room areas. Both units will be approximately 3,200 CFM and will include a supply and exhaust fan with VFDs, 200 MBH output gas fired heating section with modulating capacity control, DX cooling for dehumidification and MERV 13 filtration. Supply air ventilation will be provided to each space through new galvanized supply duct which will travel throughout each locker room area to a series of ceiling mounted supply registers. New exhaust air ductwork and air distribution devices shall be installed and shall be routed from the locker and team rooms to the new air handling units.

H. Auditorium and Stage:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

The auditorium and stage will be provided with new air handling units of the recirculation design capable of providing 100% outside air variable volume displacement ventilation air distribution to the Auditorium and Stage areas.

RTU-27: The Auditorium unit will be approximately 10,000 CFM and will include supply and return fans with VFDs, 480 MBH output gas fired heating section with modulating capacity control, 35 ton DX cooling system and MERV 13 filtration.

RTU-28: The stage unit will be approximately 4,000 CFM and will include supply and return fans with VFD's, 180 MBH gas-fired heating section with modulating capacity control, 10 ton DX cooling system and MERV 13 filtration.

Supply air ventilation to the auditorium will be provided to the space through a galvanized steel supply duct distribution system that will connect to displacement diffusers under the seating. In addition, carbon dioxide controls will be installed which will monitor the overall level of carbon dioxide at a threshold level of 800 ppm. As levels drop generally relating to a reduction in population the air handling unit outside air damper will modulate to reduce air flow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the units by return air registers located high on walls within the space or near the ceiling of the space.

I. Music/Chorus/Band/Practice rooms***:***
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

It is proposed that new dehumidification ventilation systems are installed to serve the Music, Chorus, Band and Practice classroom areas under this Option.

A rooftop air handling unit with supply and return fan with VFDs, energy recovery wheels, gas fired heating and DX cooling with modulating capacity control, sensible reheat wheel or heat pipe, and MERV 13 filtration will be provided to serve the new displacement ventilation system. Supply air will be provided to the space through new insulated, galvanized steel supply duct distribution system and shall be connected to wall mounted displacement ventilation diffusers located within the classrooms. Return air will be drawn back to the units by ceiling return air registers located within the classroom and will be routed back to the air handling unit by an insulated galvanized sheetmetal return air ductwork distribution system. Supplemental hot water fin tube radiation or ceiling radiant heating will be provided along exterior walls.

Each classroom will be provided with a variable air volume terminal box and CO2 sensor for demand ventilation control.

It is estimated that the following air handling equipment will be required to serve these Classroom areas:

RTU-29: One (1) rooftop air handling unit with a capacity of 3,500 CFM (15 tons cooling, 200 MBH heating output).

J. Administration Areas (HS, CTC, Guidance & Marketing):
LEED for Schools Credit EO2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

Spatial heating and air-conditioning for the HS, CTC Administration area, Marketing and Guidance offices will be served by horizontal ceiling concealed type ducted 4-pipe heating and cooling active chilled beam induction units with hot water and chilled water for the induction unit system provided by the individual hot water and chilled water central recirculation piping system communicating with the boiler and chilled water power plants.

RTU-30: A rooftop air handling will serve the Administration office areas and the Town Square and Forum areas of the building. The unit capacity will be approximately 10,500 CFM and will include supply and return fan with VFDs, 450 MBH output gas fired heating section with modulating capacity control, MERV 13 filtration, 32 ton capacity DX cooling section, and exhaust air energy recovery wheel. Supply air ventilation will be provided to each space that will satisfy building code requirements based on population.

RTU-31: A rooftop air handling will serve the HS Administration office areas and the Town Square and Forum areas of the building. The unit capacity will be approximately 2,500 CFM and will include supply and return fan with VFDs, 150 MBH output gas fired heating section with modulating capacity control, MERV 13 filtration, 10 ton capacity DX cooling section, and exhaust air energy recovery wheel. Supply air ventilation will be provided to each space that will satisfy building code requirements based on population.

K. Town Square/Forum:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

Spatial heating and air-conditioning for the Town Square and Forum area will be served by horizontal ceiling concealed type ducted 4-pipe heating and cooling active chilled beam induction units with hot water and chilled water for the induction unit system provided by the individual hot water and chilled water central recirculation piping system communicating with the boiler and chilled water power plants.

RTU-30: Please refer to Administration Area RTU description.

L. Kitchen:
LEED for Schools Credit EP2

The kitchen area shall be provided with new kitchen exhaust air fan and make-up air handling unit with hot water heating. The kitchen will be heated by a heating and ventilation air-handling units with gas fired heating, MUA-1 unit.

A variable volume kitchen exhaust hood control system consisting of kitchen exhaust stack temperature and smoke density sensors, supply and exhaust fan variable speed drives and associated controller will be provided by the kitchen equipment vendor. This system installation shall be field installed and coordinated with the ATC and Electrical contractors.

M. Culinary:
LEED for Schools Credit EP2

The Culinary area shall be provided with new kitchen exhaust air fan and make-up air handling unit with hot water heating. The kitchen will be heated by a heating and ventilation air-handling units with gas-fired heating, MUA-2 unit.

A variable volume kitchen exhaust hood control system consisting of kitchen exhaust stack temperature and smoke density sensors, supply and exhaust fan variable speed drives and associated controller will be provided by the kitchen equipment vendor. This system installation shall be field installed and coordinated with the ATC and Electrical contractors.

N. Wood Shop:

RTU-32: The wood shop will be provided with a gas fired roof mounted air handling unit of 100% outside air design. The unit will have a capacity of 6,000 CFM with 300 MBH output heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 800 ppm and room temperature and humidity set points.

Also located within the wood shop will be a fully engineered dust collection system with all associated controls, filters, rotary valves and safety features such as explosion proof motors and fire extinguishing device located within the ductwork. Blast gates will also be provided for each piece of equipment. All ductwork shall be designed for high velocity systems with gasket locked connections. The system shall have a capacity of approximately 6000 cfm. A typical manufacture of this system would be Donaldson Torit, model DFO.

The system shall be equipped with a listed spark detection system locate down the duct upstream of the collector and downstream from the last material entry point. A high speed abort gate activated by the spark detector shall divert any burning material to atmosphere before it can enter the building. The abort gate shall have a manual reset so that after it has aborted, it can be reset to the normal position. A typical manufacture of this system would be GreCon, model RBS-2.

O. Welding Shop / Pre-Engineering:

RTU-33: The Welding shop and Pre-Engineering Shop will be provided with a gas fired roof mounted air handling unit of the 100% outside air design. The unit will have a capacity of 6,000 CFM with 300 MBH output heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air

will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the welding shop will be welding boots, which will require the appropriate exhaust systems. Each welding station will be provided with its own separate exhaust drop for individual exhaust air capture. Two exhaust fans at approximately 1500 cfm each.

P. Auto Technology Shop:

The Auto Tech/Auto Body and Building Technologies Building will be served by its own dedicated hot water boiler heating plant and gas-fired rooftop air handling units. It is estimated that three (3) wall mounted high efficiency gas fired boilers, each with a capacity of 330 MBH, will be provided to serve building hot water radiation and terminal heating equipment. In addition to the boilers, new hot water pumps equipped with VFD drives, hot water piping, valves, accessories and controls shall be provided as part of the boiler plant heating system.

RTU-34: The Auto Technology shop will be provided with a gas fired roof mounted air-handling unit of the 100% outside air design. The unit will have a capacity of 3,500 CFM with 200 MBH output heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 800 ppm and room temperature and humidity set points.

Also located within the shop will be a fully engineered vehicle capture exhaust system which will be utilized to capture the exhaust fumes of the small engines during start up procedures or demonstrations. The system will have an approximate capacity of 2000 CFM and will consist of explosion proof motors.

Q. Auto Body Collision Shop:

RTU-35: The Auto Body Collision shop will be provided with a gas fired roof mounted air-handling unit of the 100% outside air design. The unit will have a capacity of 8,000 CFM with 400 MBH output of heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 1000 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow

ventilation while always maintaining a maximum of 800 ppm and room temperature and humidity set points.

Also located within the shop will be a fully engineered vehicle capture exhaust system which will be utilized to capture the exhaust fumes of the engines during start up procedures or demonstrations. The system will have an approximate capacity of 5000 CFM and will consist of explosion proof motors.

A paint booth will also be located within the shop area and will be provided with a packaged exhaust system with explosion proof motors sized at an approximate capacity of 12,000 cfm. To maintain neutral pressure within the space once the exhaust systems are activated the paint booth will be provided with its own dedicated make up air unit, MAU-3, to maintain a neutral pressure within the paint booth. The paint booth will operate as its own independent system rather than interlocking it with the shops air handling unit. This will prevent oversizing of the shops unit and consume less energy.

R. Building Technology Shop:

RTU-36: The Building Technology shop will be provided with a gas fired roof mounted air handling unit of 100% outside air design. The unit will have a capacity of 6,000 CFM with 300 MBH output of heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 800 ppm and room temperature and humidity set points.

Also located within the wood shop will be a fully engineered dust collection system with all associated controls, filters, rotary valves and safety features such as explosion proof motors and fire extinguishing device located within the ductwork. Blast gates will also be provided for each piece of equipment. All ductwork shall be designed for high velocity systems with gasket locked connections. The system shall have a capacity of approximately 4000 cfm. A typical manufacture of this system would be Donaldson Torit, model DFO.

The system shall be equipped with a listed spark detection system locate down the duct upstream of the collector and downstream from the last material entry point. A high speed abort gate activated by the spark detector shall divert any burning material to atmosphere before it can enter the building. The abort gate shall have a manual reset so that after it has aborted, it can be reset to the normal position. A typical manufacture of this system would be GreCon, model RBS-2.

S. Electrical Shop:

RTU-37: The Building Technology shop will be provided with a gas fired roof mounted air handling unit of 100% outside air design. The unit will have a capacity of 6,200 CFM with 300 MBH of heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and

carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 800 ppm and room temperature and humidity set points.

T. Lobby, Corridor, and Entry Way Heating:

New hot water convectors, cabinet unit heaters and fin tube radiation heating equipment shall be installed to provide heating to these areas. Corridors shall be ventilated from adjacent air handling unit systems.

U. Custodial Support Areas:

HVU-1: Custodial support areas will be heated and ventilated by a heating and ventilation unit with an estimated capacity of 1,800 CFM. Storage areas will be heated by radiation heating equipment. Horizontal type unit heaters will heat areas adjacent to the loading dock. All custodial closets will be exhausted by exhaust air fan systems.

V. Utility Areas:

Utility areas will be provided with exhaust air fan systems for ventilation, and will typically be heated with horizontal type ceiling suspended unit heaters.

The main IDF room will be air conditioned by high efficiency ductless AC cooling units.

W. Animal Science Building:

The Animal Science Building will be served by its own dedicated hot water boiler heating plant and gas-fired rooftop air handling units. It is estimated that three (3) wall mounted high efficiency gas fired boilers, each with a capacity of 330 MBH, will be provided to serve building hot water radiation and terminal heating equipment. In addition to the boilers, new hot water pumps equipped with VFD drives, hot water piping, valves, accessories and controls shall be provided as part of the boiler plant heating system.

The primary mechanical ventilation system for the Animal Science Building will include (1) air handling unit of the 100% outside air design. The unit will have a capacity of approximately 13,000 CFM with 550 MBH of heating. The unit will include a supply and exhaust fan, gas fired furnace with modulating gas valve, MERV 13 filtration and exhaust air energy recovery wheel. Supply air ventilation will be provided to occupied areas of the building including Classrooms, locker rooms, and Storage area of the building that will satisfy building code requirements. Carbon dioxide controls will be provided that will monitor the overall level of carbon dioxide.

The Classrooms will be served by individual heating and cooling high efficiency heat pump AC units. The heat pump will be a concealed ceiling unit or a wall mounted unit pending on ceiling space. Ventilation air from the building ventilation unit or an exterior wall louver will be utilized to meet code required ventilation rates. These heat pumps will have associated grade mounted condensers and refrigerant lines which will communicate

the interior unit to the roof mounted unit. Supplemental hot water radiation heating will also be provided in the classrooms.

Miscellaneous Systems:

1. In-line or roof exhaust fans shall be provided to serve the areas of the building that require separate dedicated exhaust systems utilizing exhaust air fans, ductwork and associated controls.

2. All exterior stairways, entrances and vestibules will be provided with hot water cabinet unit heaters.

3. Ancillary spaces will be heated by fin tube radiation and/or convectors.

X. Modular Classrooms:

The modular classroom building shall be served by packaged rooftop gas-fired heating and heat pump direct expansion (DX) air conditioning units. It is estimated that approximately (4) four rooftop units will be required. Each unit will have an approximate capacity of 3,600 CFM, 120 MB heating furnace and 10 tons DX cooling. Units will be equipped with supply and exhaust fans, gas fired heating, DX cooling section and MERV-13 filters. Overhead supply and return insulated galvanized sheet metal ductwork will be routed from the rooftop units to each of the classrooms. It is estimated that each unit will serve four classrooms. Zone damper controls will be provided to provide individual room temperature control for each classroom. Electric baseboard heating will be provided at the entryway and in corridors and restrooms. Exhaust air fan systems will be provided for the Modular Classroom building toilet rooms.

Y. Testing, Adjusting, Balancing & Commissioning:

All new HVAC systems shall be tested, adjusted, balanced and commissioned as part of the project scope.

Z. Automatic Temperature Controls – Building Energy Management System

A new DDC (direct digital control) automatic temperature control and building energy management system shall be installed to control and monitor building HVAC systems. Energy metering shall be installed to monitor the energy usage of building HVAC systems and utilities (fuel, gas, water).

The control system shall be as manufactured by Johnson Controls, Honeywell, Siemens or equal.

5. PHASING AND DEMOLITION REQUIREMENTS:

The project will be constructed in a phased manner. Refer to Architectural drawings/narratives for phasing requirements

Demolition: Existing heating, ventilation and air conditioning systems and equipment shall be demolished in a phased manner consistent with the Architect's project Phasing Plans.

During all Phases of Construction, SMACNA IAQ Guidelines for Occupied Building Under Construction, 2007 shall be meet to maintain proper indoor air quality with in the occupied areas. Areas to remain occupied shall be positively pressured in relationship to the construction zone to prevent constitution debris from entering the occupied areas. Construction areas shall be exhausted to prevent construction debris from entering the occupied areas. All return grilles shall be covered with MERV-8 filter media, all fresh air supply units shall be provided with MERV-13 media and all filter media shall be changed on a regular basis in accordance with SMACNA IAQ Guidelines to maintain the IAQ with in the occupied areas.

All new ductwork shall be installed per SMACNA guidelines for "Duct Cleanliness for New Construction Guidelines". A high level of indoor air quality shall be maintained throughout the duration of the project renovation construction phase.

Testing, Balancing and Commissioning: A complete HVAC system Testing and Balancing, encompassing all HVAC systems and equipment installed during each phase, shall be performed at the completion of each phase.

6. TESTING REQUIREMENTS:

   A. The mechanical contractor shall provide testing of the following systems with the owner and owner's representative present:

      1. Boiler plant system

      2. Chilled water plant system

      3. Air handling unit systems including all rooftop units, indoor air handling systems and exhaust air systems

      4. Terminal heating and cooling devices

      5. Automatic temperature control and building energy management system

   B. Testing reports shall be submitted to the engineer for review and approval before providing to the owner.

7. OPERATION MANUALS AND MAINTENANCE MANUALS: When the project is completed, the mechanical contractor shall provide operation and maintenance manuals to the owner.

8. RECORD DRAWINGS AND CONTROL DOCUMENTS: When the project is completed, an as-built set of drawings, showing all mechanical system requirements from contract and addendum items will be provided to the owner.

9. COMMISSIONING: The project shall be commissioned per Section 018000 of the specifications.

Dover High School and Technical Career Center
Dover, NH
J#831 044 00.00
L#47901/Page 1/May 15, 2015

ELECTRICAL SYSTEMS NARRATIVE REPORT

OPTION 1 - FULL REHABILITATION

The following is the Electrical System Narrative, which defines the scope of work and capacities of the Power and Lighting System as well as the Basis of Design. The electrical systems shall be designed and constructed in accordance with ***LEED Version 4*** where indicated on this narrative. This project shall conform to LEED Silver rating.

1. CODES

All work installed under Division 26 shall comply with the New Hampshire State Building Code (IBC 2009), and all local, state fire code Saf-C 6000, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT

The work of Section 260000 is indicated in this narrative report. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Electrical work and all items incidental thereto, including commissioning and testing.

3. SEQUENCE OF OPERATIONS AND INTERACTIONS

A. Classroom and corridor lighting will be controlled via “addressable relays”, which is achieved through programming. The control of the relays shall be by automatic means such as an occupancy sensor in each classroom.

B. Exterior lighting will be controlled by photocell “on” and “schedule” for “off” operation. The vehicle circulation area lighting will be controlled by “zones” and will have dimming-level control.

C. Emergency and exit lighting will be run through life safety panels to be on during normal power conditions as well as power outage conditions.

4. DESCRIPTION OF THE SYSTEMS

A. Electrical Distribution System:

1. Service ratings are designed for a demand load of 10 watts/s.f. The service capacity will be sized for 3000 amperes with 100 percent rating at 277/480 volt, 3 phase, 4 wire. New lighting and power panels will be provided to accommodate respective loads. The equipment will be located in dedicated rooms or closets.

2. The new electrical main service will be located in the existing main electrical room. The main electrical room will be constructed as part of Phase Two.

B. Interior Lighting System:

1. Classroom lighting fixtures consist of recessed mounted direct LED luminaries with dimming drivers. The fixtures will be pre-wired for dimming control where

natural daylight is available and also for multi-level switching. Office lighting fixtures will consist of similar fixtures to classrooms. Offices on the perimeter with windows shall have daylight dimming controls**.** In existing building recessed LED panel fixtures will be used.

In general lighting power density will be 40 percent less than IECC 2009.

2. Lighting levels will be approximately 30 foot candles in classrooms and offices.

3. Gymnasium lighting will be comprised of direct LED fixtures with dimming drivers. The fixtures will be provided with protective wire guards. The light level will be designed for approximately 50 foot candles.

   Daylight dimming will be provided within 15 feet of skylights or glazing. Daylight dimming controls will be similar in operation to classrooms.

4. Corridor lighting will be comprised of linear direct lighting using LED light source. The corridor light level will be designed for approximately 15 foot candles. Corridor lighting will be on a schedule through the DDC system control and only "on" during occupied hours. The corridor lighting will have two level control.

5. Cafeteria lighting will be pendant mounted/indirect fluorescent fixtures with electronic ballasts. The light levels will be designed for approximately 20 foot candles.

6. Kitchen and Servery lighting will consist of recessed 2 ft. x 2 ft. lensed gasketed LED panels. Light levels will be approximately 50 foot candles.

7. Library lighting will consist of direct recessed LED fixtures with dimmable drivers. Light levels will be approximately 30 foot candles.

8. Each area will be locally switched and designed for multi-level controls. Each classroom, office space and toilet rooms will have an occupancy sensor to turn lights off when unoccupied. Daylight sensors will be installed in each room where natural light is available for dimming of light fixtures.

9. The entire school will be controlled with an automatic lighting control system using the DDC control system for schedule programming of lights.

C. Emergency Generator Power:

1. An exterior 300 kW natural gas emergency generator with sound attenuated enclosure will be provided. Light fixtures and LED exit signs will be installed to serve all egress areas such as corridors, intervening spaces, toilets, stairs, and exit discharge exterior doors. The administration area lighting and selected receptacles will be connected to the emergency generator.

2. The generator will be sized to include fire safety systems, boilers and circulating pumps, refrigeration equipment, communications systems, etc.

D. Site Lighting System

1. Fixtures for area lighting will be pole mounted cut-off 'LED' luminaries in the entry drive and drop-off area. The fixtures shall be per *Town of Brookline standards.* The exterior lighting will be connected to the automatic lighting control system for photocell on and timed off operation. The site lighting fixtures will be dark sky compliant. The illumination level is 0.50 fc for parking areas.

2. Building perimeter fixtures will be 'LED' wall-mounted, cut-off over exterior doors for exit discharge.

E. Wiring Devices:

1. Each classroom will have a minimum of two duplex receptacles per teaching wall and two double duplex receptacles on dedicated circuits at classroom computer workstations. The teacher's workstation will have a double duplex receptacle, also on a dedicated circuit.

2. Office areas will generally have one duplex outlet per wall. At each workstation a double duplex receptacle will be provided.

3. Corridors will have a cleaning receptacle at approximately 25 ft. intervals.

4. Exterior weatherproof receptacles with lockable enclosures will be installed at exterior doors.

5. A system of computer grade panelboards with double neutrals and transient voltage surge suppressors will be provided for receptacle circuits.

6. Certain plug loads such as copiers, printers, and electric water coolers will be controlled by the DDC system for shutdown on a schedule basis.

F. Fire Alarm System:

1. A fire alarm and detection system will be provided with battery back-up. The system will be of the addressable type where each device will be identified at the control panel and remote annunciator by device type and location to facilitate search for origin of alarms.

2. Smoke detectors will be provided in open areas, corridors, stairwells and other egress ways.

3. The sprinkler system will be supervised for water flow and tampering with valves.

4. Speaker/strobes will be provided in egress ways, classrooms, assembly spaces, open areas and other large spaces. Strobe-only units will be provided in single toilets and conference rooms.

5. Manual pull stations will be provided at exit discharge doors and at each egress stairwell not located at grade level.

6. The system will be remotely connected to automatically report alarms to fire department via an approved method by the fire department.

G. Uninterruptible Power Supply (UPS):

1. Two (2) 30kw, three-phase centralized UPS systems will be provided with battery back-up.

2. The system will provide conditioned power to sensitive electronic loads, telecommunication systems, bridge over power interruptions of short duration and allow an orderly shutdown of servers, communication systems, etc. during a prolonged power outage.

3. The UPS systems will also be connected to the standby generator.

5. TESTING REQUIREMENTS

The Electrical Contractor shall provide testing of the following systems with the Owner and Owner's representative present:

- Lighting and power panels for correct phase balance.
- Emergency generator.
- Lighting control system (interior and exterior).
- Fire alarm system.
- Security system.

Testing reports shall be submitted to the engineer for review and approval before providing to the Owner.

6. OPERATION MANUALS AND MAINTENANCE MANUALS:

When the project is completed, the Electrical Contractor shall provide operation and maintenance manuals to the Owner.

7. RECORD DRAWINGS AND CONTROL DOCUMENTS:

When the project is complete, an as-built set of drawings, showing all lighting and power requirements from contract and addendum items, will be provided to the Owner.

8. COMMISSIONING

The project will be commissioned per Section 018100 of the specifications.

9. CCTV

A Closed Circuit TV system will consist of computer servers with image software, computer monitors and IP based closed circuit TV cameras. The head end server will be located in the head end MDF room and will be rack-mounted. The system can be accessed from any PC within the facility or externally via an IP address. Each camera can be viewed independently. The

network video recorders NVR's will record all cameras and store this information for 21 days at 15 images per second (virtual real time).

The location of the cameras is generally in corridors and exterior building perimeter. The exterior cameras are pan-tilt-zoom type.

The system will fully integrate with the access control system to allow viewing of events from a single alarm viewer. Camera images and recorded video will be linked to the access system to allow retrieval of video that is associated with an event.

10. INTRUSION SYSTEM

An intrusion system will consist of security panel, keypads, motion detectors and door contacts. The system is addressable which means that each device will be identified when an alarm occurs. The system is designed so that each perimeter classroom with grade access will have dual tech sensors along the exterior wall and corridors, and door contacts at each exterior door.

The system can be partitioned into several zones. Therefore, it is possible to use the Gym area while the remainder of the school remains alarmed.

The system will include a digital transmitter to summons the local police department in the event of an alarm condition

The intrusion system will be connected to the automated lighting control system to automatically turn on lighting upon an alarm.

11. CARD ACCESS

A card access system includes a card access controller, door controllers and proximity readers/keypads. Proximity readers will be located at various locations. Each proximity reader will have a distinctive code to identify the user and a log will be kept in memory. The log within the panel can be accessed through a computer.

The alarm condition will also initiate real time recording on the integrated CCTV System. The system may be programmed with graphic maps allowing the end user to quickly identify alarm conditions and lock/unlock doors.

The system is modular and may be easily expanded to accommodate any additional devices.

12. PHASING

Phasing will occur over a 4-year period. The main electrical service will be provided under Phase 2 with all the distribution equipment being provided for all phases. Each phase shall be provided with lighting, power and mechanical panels for respective year; therefore, remote panels will be purchased during respective phase time frame. For example, year four panels will be provided in year four.

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47922/Page 1/May 15, 2015

PLUMBING SYSTEMS NARRATIVE REPORT

OPTION 1 – FULL REHABILITATION

The following is the Plumbing system narrative, which defines the scope of work and capacities of the Plumbing system as well as the Basis of Design. The Plumbing Systems shall be designed and constructed for ***LEED for Schools*** where indicated on this narrative.

1. CODES

   A. All work installed under Section 220000 shall comply with the NH Building Code, MA Plumbing Code and all state, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT

   A. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Plumbing work and all items incidental thereto, including commissioning and testing.

3. GENERAL

   A. The Plumbing Systems that will serve the project are cold water, hot water, tempered water, sanitary waste and vent system, grease waste system, special waste system, storm drain system, natural gas and compressed air.

   B. The Buildings will be serviced by Municipal water and Municipal sewer system.

   C. All Plumbing in the building will conform to Accessibility Codes and to Water Conserving sections of the Plumbing Code.

4. DRAINAGE SYSTEM

   A. Soil, Waste, and Vent piping system is provided to connect to all fixtures and equipment. System runs from 10 feet outside building and terminates with stack vents through the roof.

   B. A separate Grease Waste System starting with connection to an exterior concrete grease interceptor running thru the new kitchen and servery area fixtures and terminating with a vent terminal through the roof. Point of use grease interceptors are to be provided at designated kitchen fixtures. The grease interceptor is provided under Division 33 scope.

   C. Storm Drainage system is provided to drain all roofs with roof drains piped through the building to a point 10 feet outside the building.

   D. Drainage system piping will be service weight cast iron piping; hub and spigot with gaskets for below grade; no hub with gaskets, bands and damps for above grade 2 in. and larger. Waste and vent piping 1-1/2 in. and smaller will be type ‘L’ copper.

E. A separate Special Waste System shall be provided in the main Building and Animal Science Building, starting with a connection to an interior limestone chip acid neutralizer, running thru the building to collect science classroom fixtures and terminating with vent terminals through the roof. Special Waste and Vent piping will be Schedule 40 electric heat fused polypropylene piping, fittings and traps, flame retardant above grade and non-flame retardant below ground.

5. WATER SYSTEM

A. New 4 inch domestic water service from the municipal water system will be provided to the Animal Science and Technology buildings. A meter and backflow preventer, if required, will be provided. New water distribution will be provided from the addition to the existing building. Existing water services in main building will be reused.

B. New cold water distribution mains will be provided in all buildings. Non-freeze wall hydrants with integral back flow preventers are provided along the exterior of the building.

C. Domestic hot water heating will be provided with a combination of gas fired, high efficiency, and condensing water heaters with separate storage tank. System is to be equipped with thermostatically controlled mixing devices to control water temperature to the fixtures.

D. A pump will re-circulate hot water from the piping system. Water temperature will be 120 deg. to serve general use fixtures. A 140 deg. F hot water will be supplied to the kitchen dishwasher.

E. Water piping will be type ‘L’ copper with wrot copper sweat fittings, silver solder or press-fit system. All piping will be insulated with 1 in. thick high density fiberglass.

6. GAS SYSTEM

A. Natural gas service will be provided for the building and will serve the boilers, domestic water heaters, kitchen cooking equipment, roof top equipment and generator.

B. Gas piping will be Schedule 40 black steel pipe with threaded gas pattern malleable fittings for 2 in. and under and butt welded fittings for 2-1/2 in. and larger.

7. COMPRESSED AIR SYSTEM

A. Compressed air will be provided for the Technology Building.

B. Compressed air piping will be Schedule 40 black steel pipe with threaded gas pattern malleable fittings.

8. FIXTURES ***LEED for Schools Credit WEp1 & WEc3***

A. Furnish and install all fixtures, including supports, connections, fittings, and any incidentals to make a complete installation.

B. Fixtures shall be the manufacturer's guaranteed label trademark indicating first quality. All acid resisting enameled ware shall bear the manufacturer's symbol signifying acid resisting material.

C. Vitreous china and acid resisting enameled fixtures, including stops, supplies and traps shall be of one manufacturer by Kohler, American Standard, or Eljer, or equal. Supports shall be Zurn, Smith, Josam, or equal. All fixtures shall be white. Faucets shall be Speakman, Chicago, or equal.

D. Fixtures shall be as scheduled on drawings.

1. Water Closet: High efficiency toilet, 1.28 gallon per flush, wall hung, vitreous china, siphon jet. Manually operated 1.28 gallon per flush-flush valve.

2. Urinal: High efficiency 0.13 gallon per flush urinal, wall hung, vitreous china. Manually operated 0.13 gallon per flush-flush valve.

3. Lavatory: Wall hung/countertop ADA lavatory with 0.5 GPM metering mixing faucet programmed for 10 second run-time cycle.

4. Sink: Elkay ADA stainless steel countertop sink with Chicago 201A faucet and 0.5 GPM aerator.

5. Drinking Fountain: Halsey Taylor hi-low wall mounted electric water cooler, stainless steel basin with bottle filling stations.

6. Janitor Sink: 24 x 24 x 10 Terrazo mop receptor Stern-Williams or equal.

7. Laboratory Sinks: Faucets with vacuum breakers and 0.74 GPM aerators.

9. DRAINS

A. Drains are cast iron, caulked outlets, nickaloy strainers, and in waterproofed areas and roofs shall have galvanized iron clamping rings with 6 lb. lead flashings to bond 9 in. in all directions. Drains shall be Smith, Zurn, Josam, or equal.

10. VALVES

A. Locate all valves so as to isolate all parts of the system. Shutoff valves 3 in. and smaller shall be ball valves, solder end or screwed, Apollo, or equal.

11. INSULATION

A. All water piping shall be insulated with snap-on fiberglass insulation Type ASJ-SSL, equal to Johns Manville Micro-Lok HP.

12. CLEANOUTS

A. Cleanouts shall be full size up to 4 in. threaded bronze plugs located as indicated on the drawings and/or where required in soil and waste pipes.

B. Cleanouts for Special Waste System shall be Zurn #Z9A-C04 polypropylene cleanout plug with Zurn #ZANB-1463-VP nickel bronze scoriated floor access cover.

13. ACCESS DOORS

A. Furnish access doors for access to all concealed parts of the plumbing system that require accessibility. Coordinate types and locations with the Architect.

14. WATER HEATER

A. Gas fired, high efficiency, condensing water heaters with separate storage tank.

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47918/Page 1/May 15, 2015

FIRE PROTECTION SYSTEMS NARRATIVE REPORT

OPTION 1 – FULL REHABILITATION

The following is the Fire Protection system narrative, which defines the scope of work and capacities of the Fire Protection system as well as the Basis of Design.

1. CODES

   A. All work installed under Section 210000 shall comply with the MA Building Code and all state, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT

   A. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Fire Protection work and all items incidental thereto, including commissioning and testing.

3. DESCRIPTION

   A. The existing building to remain is currently protected with an automatic sprinkler system. This system will be maintained and modified to protect renovated areas.

   B. The two new buildings will be protected with automatic sprinklers systems and be served independently by a new 6 inch fire service, double check valve assembly, wet alarm valve complete with electric bell, and fire department connection meeting local thread standards.

   B. System will be a sprinkler system installed in accordance with NFPA 13-2013.

   C. All areas of the new buildings, including all finished and unfinished spaces, combustible concealed spaces, all electrical rooms and closets will be sprinklered.

   E. All sprinkler heads will be quick response, pendent in hung ceiling areas and upright in unfinished areas.

5. BASIS OF DESIGN

   A. The mechanical rooms, kitchen, science classrooms, and storage rooms are considered Ordinary Hazard Group 1; stage and vocational shops considered Ordinary Hazard Group 2; all other areas are considered light hazard.

   B. Required Design Densities:

Light Hazard Areas	0.10 GPM over 1,500 s.f.
Ordinary Hazard Group 1	0.15 GPM over 1,500 s.f.
Ordinary Hazard Group 2	0.20 GPM over 1,500 s.f.

C. Sprinkler spacing (max.):

Light Hazard Areas:	225 s.f.
Ordinary Hazard Areas:	130 s.f.

D. A flow test will be required to be performed to confirm the Municipal water supply.

6. PIPING

A. Sprinkler piping 1-1/2 in. and smaller shall be ASTM A-53, Schedule 40 black steel pipe. Sprinkler/standpipe piping 2 in. and larger shall be ASTM A-135, Schedule 10 black steel pipe.

7. FITTINGS

A. Fittings on fire service piping, 2 in. and larger, shall be Victaulic Fire Lock Ductile Iron Fittings conforming to ASTM A-536 with integral grooved shoulder and back stop lugs and grooved ends for use with Style 009-EZ or Style 005 couplings. Branch line fittings shall be welded or shall be Victaulic 920/920N Mechanical Tees. Schedule 10 pipe shall be roll grooved. Schedule 40 pipe, where used with mechanical couplings, shall be roll grooved and shall be threaded where used with screwed fittings. Fittings for threaded piping shall be malleable iron screwed sprinkler fittings.

8. JOINTS

A. Threaded pipe joints shall have an approved thread compound applied on male threads only. Teflon tape shall be used for threads on sprinkler heads. Joints on piping, 2 in. and larger, shall be made up with Victaulic, or equal, Fire Lock Style 005, rigid coupling of ductile iron and pressure responsive gasket system for wet sprinkler system as recommended by manufacturer.

9. DOUBLE CHECK VALVE ASSEMBLY

A. Double check valve assembly shall be New Hampshire State approved, U.L./F.M. approved, with iron body bronze mounted construction complete with supervised OS & Y gate valves and test cocks. Furnish two spare sets of gaskets and repair kits.

B. Double check valve detector assembly shall be of one of the following:

1. Watts Series 757-OSY
2. Wilkins 350A-OSY
3. Conbraco Series 4S-100
4. Or equal

10. PHASING

A. Phasing will occur over a 4-year period. The detection/suppression systems shall be tested as each phase is completed so that system testing and acceptance procedures will be performed prior to occupancy of each individual area of a building.

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47910/Page 1/May 15, 2015

TECHNOLOGY SYSTEMS NARRATIVE REPORT

OPTION 1 - FULL REHABILITATION OPTION

The following is the Technology System narrative, which defines the scope of work and capacities of the Communications system infrastructure and Security system as well as the Basis of Design.

1. CODES

   A. All work installed under Section 270000 shall comply with the New Hampshire Building Code, IBC 2009, and all local, county, and federal codes, laws, statues, and authorities having jurisdiction.

2. DESIGN INTENT

   A. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Technology and Security work and all items incidental thereto, including commissioning and testing.

3. TECHNOLOGY

   A. The data system infrastructure will consist of fiber optic backbone cabling horizontal wiring will consist of Category 6A UTP Plenum rated cabling for both data and telephone systems for gigabit connectivity. The telephone infrastructure will accommodate PBX, or VOIP based voice systems. A new IP telephone system will be used.

   B. Each classroom will have 4 data outlets for student computers. Two data, one voice with video and audio connections to a wall-mounted interactive projector or touchscreen will be provided at teacher's station with interconnectivity to a interactive whiteboard. A wall phone outlet with 2 way ceiling speaker will be provided for communications with administration. Wireless access points will be provided in all classrooms and other spaces in addition to (2) CAT6A.cables to access points multimode fiber will also be provided.

   C. A central paging system will be provided and integrated with the telephone system. The paging speakers will be IP.

   D. A wireless GPS/LAN based master clock system will be provided with 120V wireless remote clocks that act as transceivers.

   E. The Main Distribution Frame (MDF) will contain all core network switching and IP voice switch. Intermediate Distribution Frames (IDFs) will serve each floor/wing of the school. A fiber optic backbone will be provided from each IDF to MDF. The backbone will be designed for 10 Gbps Ethernet.

4. TESTING REQUIREMENTS

A. The Technology and Security Contractors shall provide testing of the following systems with the Owner and Owner's representative present:

- Telephone and data cabling
- Fiber optic backbone cabling
- Paging system
- Wireless clock system
- A/V wiring for classrooms

Testing reports shall be submitted to the engineer for review and approval before providing to the Owner.

5. OPERATION MANUALS AND MAINTENANCE MANUALS:

A. When the project is completed, the Technology Contractor shall provide operation and maintenance manuals to the Owner.

6. RECORD DRAWINGS AND CONTROL DOCUMENTS:

A. When the project is completed, an as-built set of drawings, showing all lighting and power requirements from contract and addendum items, will be provided to the Owner.

7. COMMISSIONING

A. The project shall be commissioned per Commissioning Section of the specifications.

8. PHASING

A. The existing telephone, internet and cable-TV services will be impacted by phasing. The existing head end room will be back-fed from a new head end room under Phase 2. New IDF closets will be provided throughout each phase. Existing IDF closets will require temporary back-feed to maintain connectivity.

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47906/Page 1/May 15, 2015

HVAC SYSTEMS NARRATIVE REPORT

OPTION 2B – RENOVATION / ADDITION

The following is the HVAC system narrative, which defines the scope of work and capacities of the HVAC system as well as the Basis of Design. The HVAC systems shall be designed and constructed for ***LEED for Schools*** where indicated on this narrative.

1. CODES:

   All work installed under Division 230000 shall comply with the State of New Hampshire Building Code and all local, IBC 2012, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT:

   The work of Division 230000 is described within the narrative report. The HVAC project scope of work shall consist of providing new HVAC equipment and systems as described here within. All new work shall consist of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Heating, Ventilating and Air Conditioning work and all items incidental thereto, including commissioning and testing.

3. BASIS OF DESIGN:

   Project weather and Code temperature values are listed herein based on weather data values as determined from ASHRAE weather data tables and the International Energy Conservation Code.

   Outside: Winter -2 deg. F, Summer 88 deg. F DB 73 deg. F WB

   Inside: 70 deg. F +/- 2 deg F for heating, 75 deg. F +/- 2 deg F (55% RH) for cooling for areas with air conditioning, 78 deg. F +/- 2 deg. F (<60% RH) for areas with displacement/dehumidification*(see Displacement Ventilation note below). Unoccupied temperature setback will be provided (60 deg F heating (adj.), 85 deg F cooling/dehumidification (adj.).

   Outside air shall be provided at the rate in accordance with ASHRAE guide 62.1-2010 and the International Mechanical Code as a minimum. All occupied areas will be designed to maintain 800 PPM carbon dioxide maximum.

4. SYSTEM DESCRIPTION:

   A. Central Heating Plants: ***LEED for Schools Credit EP2 & EC1***

      Heating for the entire building will be through the use of a high efficiency gas-fired condensing boiler plant.

      The new boiler plant shall be provided with (4) 2700 MBH output boilers and (2) end suction base mounted primary and standby pumps with a capacity of 720 gpm each will be located in the mechanical room. Boilers shall each be sized for approximately 33% of the building radiation heating load. In addition to new boilers and pumps, new hot water accessories including air separators and expansion tanks shall be provided.

The boiler plant will supply heating hot water to heating equipment and systems located throughout the building through a two-pipe fiberglass insulated schedule 40 black steel and copper piping system. The boiler plants shall supply a maximum hot water temperature of 160 deg F on a design heating day and the hot water supply water temperature will be adjusted downward based on an outside temperature reset schedule to improve the overall operating efficiency of the power plants. Primary and standby end suction base mounted pumps will be provided with variable frequency drives for variable volume flow through the water distribution system for improved energy efficiency.

Combustion air for each boiler will be directly ducted to each boiler through a galvanized ductwork distribution system. Venting from each boiler shall be through separate double wall aluminized stainless steel (AL29-4C) vent system and shall discharge approximately 12 feet above the roof level. Final venting height will be depending on the location of building intake air locations and adjacent roofs.

B. Central Cooling Plant: ***LEED for Schools Credit EP2 & EC1***

A high efficiency central chilled water cooling plant consisting of a 50 ton high efficiency air cooled chilled, primary and standby chilled water pumps with VFDs, each with a capacity of 110 gpm, accessories, controls and steel and copper piping distribution system shall be provided to serve chilled water cooling HVAC equipment located throughout the building. The chilled water system will consist of a 35% propylene glycol solution. A glycol make-up feed unit system shall be provided.

The chiller plant shall serve active chilled beam induction units located in the Administration, Town Square, Forum areas of the building and select classrooms that require full air conditioning.

C. Classroom Heating and Ventilation *(General Classrooms, Learning Commons, Science, Art, SPED, Cosmetology, Computer Tech/Programming, Life, Health and Family Cons Science, Pre-Engineering, ROTC)**:***
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

It is proposed that new displacement ventilation systems are installed to serve the Building classroom areas under this Option.

New air handling units with supply and return fan with VFDs, energy recovery wheels, gas fired heating and DX cooling with modulating capacity control, sensible reheat wheel or heat pipe, and MERV 13 filtration will be provided to serve the new displacement ventilation system. Supply air will be provided to the space through new insulated, galvanized steel supply duct distribution system and shall be connected to wall mounted displacement ventilation diffusers located within the classrooms. Return air will be drawn back to the units by ceiling return air registers located within the classroom and will be routed back to the air handling unit by an insulated galvanized sheet metal return air ductwork distribution system. Supplemental hot water fin tube radiation or ceiling radiant heating will be provided along exterior walls.

Each classroom will be provided with a variable air volume terminal box and CO2 sensor for demand ventilation control.

It is estimated that the following air handling equipment will be required to serve these Classroom areas:

RTU-1, 2, 3, 4: Four (4) rooftop air handling units with a capacity of 12,000 CFM (42 tons cooling, 530 MBH heating output) each, to serve the two main general classroom wings.

RTU-5: One (1) rooftop air handling unit with a capacity of 12,500 CFM (42 tons cooling, 530 MBH heating output) to serve the Science classrooms.

RTU-6: One (1) rooftop air handling unit with a capacity of 5,500 CFM (20 tons cooling, 200 MBH heating output) to serve the Art classrooms and adjacent Learning Commons.

RTU-7: One (1) rooftop air handling unit with a capacity of 3,500 CFM (15 tons cooling, 200 MBH heating output) to serve the Life Skills and SPED classrooms.

RTU-8: One (1) rooftop air handling unit with a capacity of 7,200 CFM (27 tons cooling, 350 MBH heating output) to serve the Business, Computer Technology & Programming, Life Science, Health Sciences Classroom areas.

Displacement Ventilation:

The displacement ventilation system for the classroom wings are intended to provide a maximum cooling temperature during peak cooling periods of approximately 78°F ± 2 °F, however, the ventilation air provided will be extremely dry which will be the result of utilizing refrigeration equipment and hot gas reheat to reduce vapor pressure to an extremely low condition of approximately 50 grains of moisture per pound of air and reheating the air to a supply temperature of approximately 68°F which will be distributed to each space. The extremely dry condition of the supply air provides the perception of a condition that is cooler than is actually occurring due to the evaporation of moisture to the adjacent air from the occupants of the space.

Considering maximum cooling requirements occur primarily during the months of July and August when the majority of the academic areas are not in use, it would suggest maintaining slightly higher temperatures may not present a discomfort, however, will relate to a substantial operating cost savings and a reduced installation cost.

An additional major benefit of utilizing dry air within the building will be the overall reduction of vapor pressure typically present in outside ventilation air during summer months. This reduction in vapor pressure will dramatically reduce the amount of moisture entering the building and the potential of condensation resulting in moisture, and a direct relationship with the formation of mold.

Classrooms Requiring Full Air Conditioning:

Classrooms that require full air conditioning will be provided with supplemental cooling active chilled beam induction units.

D. Gymnasium:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-9&10: The gymnasium will be served by two (2) air-handling unit of the recirculation design. The unit will be approximately 6,500 CFM and will include supply and return fans with VFDs, 320 MBH output gas-fired heating and 22 Tons DX cooling with modulating capacity control, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed maintaining a maximum of 800 PPM. Supply air ventilation will be

provided to the space through an exposed galvanized steel supply duct with drum louvers to project the air to the floor. As levels of carbon dioxide drop generally relating to a reduction in population a variable frequency drive located in each air-handling unit will modulate to reduce airflow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the air handling unit by a low wall return air register.

E. Alternate PE:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-11: The Alternate PE area will be served by a rooftop air-handling unit of the recirculation design. The unit will be approximately 2,500 CFM and will include supply and return fans with VFDs, 130 MBH output gas fired heating and 7.5 Ton DX cooling with modulating capacity control, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an exposed galvanized steel supply duct with drum louvers to project the air to the floor. As levels of carbon dioxide drop generally relating to a reduction in population a variable frequency drive located in each air-handling unit will modulate to reduce airflow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the air-handling unit by a low wall return air register.

F. Fitness Room:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-12: The Fitness area will be served by an rooftop air-handling unit of the recirculation design. The unit will be approximately 2,000 CFM and will include supply and return fans with VFDs, 120 MBH output heating and 6.5 Ton DX cooling with modulating capacity control, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an exposed galvanized steel supply duct with drum louvers to project the air to the floor. As levels of carbon dioxide drop generally relating to a reduction in population a variable frequency drive located in each air-handling unit will modulate to reduce airflow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the air-handling unit by a low wall return air register.

G. Locker Rooms:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-13 & RTU-14: The Boys and Girls locker rooms, and adjacent PE office areas will be provided with new roof-mounted air handling units of the 100% outside air design with energy recovery. There will be (2) units, with one unit serving the Boy's locker room areas and the other unit serving the Girl's locker room areas. Both units will be approximately 3,200 CFM and will include a supply and exhaust fan with VFDs, 200 MBH output gas fired heating section with modulating capacity control, DX cooling for dehumidification and MERV 13 filtration. Supply air ventilation will be provided to each space through new galvanized supply duct which will travel throughout each locker room area to a series of ceiling mounted supply registers. New exhaust air ductwork and air distribution devices shall be installed and shall be routed from the locker and team rooms to the new air handling units.

H. Auditorium and Stage:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

The auditorium and stage will be provided with new air handling units of the recirculation design capable of providing 100% outside air variable volume displacement ventilation air distribution to the Auditorium and Stage areas.

RTU-15: The Auditorium unit will be approximately 10,000 CFM and will include supply and return fans with VFDs, 480 MBH output gas fired heating section with modulating capacity control, 35 ton DX cooling system and MERV 13 filtration.

RTU-16: The stage unit will be approximately 4,000 CFM and will include supply and return fans with VFD's, 180 MBH gas-fired heating section with modulating capacity control, 10 ton DX cooling system and MERV 13 filtration.

Supply air ventilation to the auditorium will be provided to the space through a galvanized steel supply duct distribution system that will connect to displacement diffusers under the seating. In addition, carbon dioxide controls will be installed which will monitor the overall level of carbon dioxide at a threshold level of 800 ppm. As levels drop generally relating to a reduction in population the air handling unit outside air damper will modulate to reduce air flow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the units by return air registers located high on walls within the space or near the ceiling of the space.

I. Music/Chorus/Band/Practice rooms***:***
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

It is proposed that new displacement ventilation systems are installed to serve the Music, Chorus, Band and Practice classroom areas under this Option.

A rooftop air handling unit with supply and return fan with VFDs, energy recovery wheels, gas fired heating and DX cooling with modulating capacity control, sensible reheat wheel or heat pipe, and MERV 13 filtration will be provided to serve the new displacement ventilation system. Supply air will be provided to the space through new insulated, galvanized steel supply duct distribution system and shall be connected to wall mounted displacement ventilation diffusers located within the classrooms. Return air will be drawn back to the units by ceiling return air registers located within the classroom and will be routed back to the air handling unit by an insulated galvanized sheetmetal return air ductwork distribution system. Supplemental hot water fin tube radiation or ceiling radiant heating will be provided along exterior walls.

Each classroom will be provided with a variable air volume terminal box and CO2 sensor for demand ventilation control.

It is estimated that the following air handling equipment will be required to serve these Classroom areas:

RTU-17: One (1) rooftop air handling unit with a capacity of 3,500 CFM (15 tons cooling, 200 MBH heating output).

J. Administration Areas (HS, CTC, Guidance & Marketing):
LEED for Schools Credit EO2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

Spatial heating and air-conditioning for the HS, CTC Administration area, Marketing and Guidance offices will be served by horizontal ceiling concealed type ducted 4-pipe heating and cooling active chilled beam induction units with hot water and chilled water for the induction unit system provided by the individual hot water and chilled water central recirculation piping system communicating with the boiler and chilled water power plants.

RTU-18: A rooftop air handling will serve the Administration office areas and the Town Square and Forum areas of the building. The unit capacity will be approximately 10,500 CFM and will include supply and return fan with VFDs, 450 MBH output gas fired heating section with modulating capacity control, MERV 13 filtration, 32 ton capacity DX cooling section, and exhaust air energy recovery wheel. Supply air ventilation will be provided to each space that will satisfy building code requirements based on population.

RTU-19: A rooftop air handling will serve the HS Administration office areas and the Town Square and Forum areas of the building. The unit capacity will be approximately 2,500 CFM and will include supply and return fan with VFDs, 150 MBH output gas fired heating section with modulating capacity control, MERV 13 filtration, 10 ton capacity DX cooling section, and exhaust air energy recovery wheel. Supply air ventilation will be provided to each space that will satisfy building code requirements based on population.

K. Town Square/Forum:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

Spatial heating and air-conditioning for the Town Square and Forum area will be served by horizontal ceiling concealed type ducted 4-pipe heating and cooling active chilled beam induction units with hot water and chilled water for the induction unit system provided by the individual hot water and chilled water central recirculation piping system communicating with the boiler and chilled water power plants.

RTU-18: Please refer to Administration Area RTU description.

L. Kitchen:
LEED for Schools Credit EP2

The kitchen area shall be provided with new kitchen exhaust air fan and make-up air handling unit with hot water heating. The kitchen will be heated by a heating and ventilation air-handling units with gas fired heating, MUA-1 unit.

A variable volume kitchen exhaust hood control system consisting of kitchen exhaust stack temperature and smoke density sensors, supply and exhaust fan variable speed drives and associated controller will be provided by the kitchen equipment vendor. This system installation shall be field installed and coordinated with the ATC and Electrical contractors.

M. Culinary:
LEED for Schools Credit EP2

The Culinary area shall be provided with new kitchen exhaust air fan and make-up air handling unit with hot water heating. The kitchen will be heated by a heating and ventilation air-handling units with gas-fired heating, MUA-2 unit.

A variable volume kitchen exhaust hood control system consisting of kitchen exhaust stack temperature and smoke density sensors, supply and exhaust fan variable speed drives and associated controller will be provided by the kitchen equipment vendor. This system installation shall be field installed and coordinated with the ATC and Electrical contractors.

N. Wood Shop:

RTU-20: The wood shop will be provided with a gas fired roof mounted air handling unit of 100% outside air design. The unit will have a capacity of 6,000 CFM with 300 MBH output heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the wood shop will be a fully engineered dust collection system with all associated controls, filters, rotary valves and safety features such as explosion proof motors and fire extinguishing device located within the ductwork. Blast gates will also be provided for each piece of equipment. All ductwork shall be designed for high velocity systems with gasket locked connections. The system shall have a capacity of approximately 6000 cfm. A typical manufacture of this system would be Donaldson Torit, model DFO.

The system shall be equipped with a listed spark detection system locate down the duct upstream of the collector and downstream from the last material entry point. A high speed abort gate activated by the spark detector shall divert any burning material to atmosphere before it can enter the building. The abort gate shall have a manual reset so that after it has aborted, it can be reset to the normal position. A typical manufacture of this system would be GreCon, model RBS-2.

O. Welding Shop / Pre-Engineering:

RTU-21: The Welding shop and Pre-Engineering Shop will be provided with a gas fired roof mounted air handling unit of the 100% outside air design. The unit will have a capacity of 6,000 CFM with 300 MBH output heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 1000 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air

will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the welding shop will be welding boots which will require the appropriate exhaust systems. Each welding station will be provided with its own separate exhaust drop for individual exhaust air capture. Two exhaust fans at approximately 1500 cfm each.

P. Auto Technology Shop:

RTU-22: The Auto Technology shop will be provided with a gas fired roof mounted air-handling unit of the 100% outside air design. The unit will have a capacity of 3,500 CFM with 200 MBH output heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 1000 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the shop will be a fully engineered vehicle capture exhaust system which will be utilized to capture the exhaust fumes of the small engines during start up procedures or demonstrations. The system will have an approximate capacity of 2000 CFM and will consist of explosion proof motors.

Q. Auto Body Collision Shop:

RTU-23: The Auto Body Collision shop will be provided with a gas fired roof mounted air-handling unit of the 100% outside air design. The unit will have a capacity of 8,000 CFM with 400 MBH output of heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 1000 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the shop will be a fully engineered vehicle capture exhaust system which will be utilized to capture the exhaust fumes of the engines during start up procedures or demonstrations. The system will have an approximate capacity of 5000 CFM and will consist of explosion proof motors.

A paint booth will also be located within the shop area and will be provided with a packaged exhaust system with explosion proof motors sized at an approximate capacity of 12,000 cfm. To maintain neutral pressure within the space once the exhaust systems are activated the paint booth will be provided with its own dedicated make up air unit, MAU-3, to maintain a neutral pressure within the paint booth. The paint booth will operate as its own independent system rather than interlocking it with the shops air handling unit. This will prevent oversizing of the shops unit and consume less energy.

R. Building Technology Shop:

RTU-24: The Building Technology shop will be provided with a gas fired roof mounted air handling unit of 100% outside air design. The unit will have a capacity of 6,000 CFM with 300 MBH output of heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the wood shop will be a fully engineered dust collection system with all associated controls, filters, rotary valves and safety features such as explosion proof motors and fire extinguishing device located within the ductwork. Blast gates will also be provided for each piece of equipment. All ductwork shall be designed for high velocity systems with gasket locked connections. The system shall have a capacity of approximately 4000 cfm. A typical manufacture of this system would be Donaldson Torit, model DFO.

The system shall be equipped with a listed spark detection system locate down the duct upstream of the collector and downstream from the last material entry point. A high speed abort gate activated by the spark detector shall divert any burning material to atmosphere before it can enter the building. The abort gate shall have a manual reset so that after it has aborted, it can be reset to the normal position. A typical manufacture of this system would be GreCon, model RBS-2.

S. Electrical Shop:

RTU-25: The Building Technology shop will be provided with a gas fired roof mounted air handling unit of 100% outside air design. The unit will have a capacity of 6,200 CFM with 300 MBH of heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

T. Lobby, Corridor, and Entry Way Heating:

New hot water convectors, cabinet unit heaters and fin tube radiation heating equipment shall be installed to provide heating to these areas. Corridors shall be ventilated from adjacent air handling unit systems.

U. Custodial Support Areas:

HVU-1: Custodial support areas will be heated and ventilated by a heating and ventilation unit with an estimated capacity of 1,800 CFM. Storage areas will be heated by radiation heating equipment. Horizontal type unit heaters will heat areas adjacent to the loading dock. All custodial closets will be exhausted by exhaust air fan systems.

V. Utility Areas:

Utility areas will be provided with exhaust air fan systems for ventilation, and will typically be heated with horizontal type ceiling suspended unit heaters.

The main IDF room will be air conditioned by high efficiency ductless AC cooling units.

W. Testing, Adjusting, Balancing & Commissioning:

All new HVAC systems shall be tested, adjusted, balanced and commissioned as part of the project scope.

X. Automatic Temperature Controls – Building Energy Management System

A new DDC (direct digital control) automatic temperature control and building energy management system shall be installed to control and monitor building HVAC systems. Energy metering shall be installed to monitor the energy usage of building HVAC systems and utilities (fuel, gas, water).

The control system shall be as manufactured by Johnson Controls, Honeywell, Siemens or Equal.

5. PHASING AND DEMOLITION REQUIREMENTS:

The project will be constructed in a phased manner. Refer to Architectural drawings/narratives for Phasing requirements

Demolition: Existing heating, ventilation and air conditioning systems and equipment shall be demolished in a phased manner consistent with the Architect's project Phasing Plans.

During all Phases of Construction, SMACNA IAQ Guidelines for Occupied Building Under Construction, 2007 shall be meet to maintain proper indoor air quality with in the occupied areas. Areas to remain occupied shall be positively pressured in relationship to the construction zone to prevent constitution debris from entering the occupied areas. Construction areas shall be exhausted to prevent construction debris from entering the occupied areas. All return grilles shall be covered with MERV-8 filter media, all fresh air supply units shall be provided with MERV-13

media and all filter media shall be changed on a regular basis in accordance with SMACNA IAQ Guidelines to maintain the IAQ with in the occupied areas.

All new ductwork shall be installed per SMACNA guidelines for "Duct Cleanliness for New Construction Guidelines". A high level of indoor air quality shall be maintained throughout the duration of the project renovation construction phase.

Testing, Balancing and Commissioning: A complete HVAC system Testing and Balancing, encompassing all HVAC systems and equipment installed during each phase, shall be performed at the completion of each phase.

6. TESTING REQUIREMENTS:

   A. The mechanical contractor shall provide testing of the following systems with the owner and owner's representative present:

      1. Boiler plant system
      2. Chilled water plant system
      3. Air handling unit systems including all rooftop units, indoor air handling systems and exhaust air systems
      4. Terminal heating and cooling devices
      5. Automatic temperature control and building energy management system

   B. Testing reports shall be submitted to the engineer for review and approval before providing to the owner.

7. OPERATION MANUALS AND MAINTENANCE MANUALS: When the project is completed, the mechanical contractor shall provide operation and maintenance manuals to the owner.

8. RECORD DRAWINGS AND CONTROL DOCUMENTS: When the project is completed, an as-built set of drawings, showing all mechanical system requirements from contract and addendum items will be provided to the owner.

9. COMMISSIONING: The project shall be commissioned per Section 018000 of the specifications.

Dover High School and Technical Career Center
Dover, NH
J#831 044 00.00
L#47899/Page 1/May 15, 2015

ELECTRICAL SYSTEMS NARRATIVE REPORT

OPTION 2B RENOVATION / ADDITION

The following is the Electrical system narrative, which defines the scope of work and capacities of the Power and Lighting system as well as the Basis of Design. The electrical systems shall be designed and constructed for ***LEED for Schools*** where indicated on this narrative. This project shall confirm to LEED Silver rating.

1. CODES

All work installed under Division 26 shall comply with the New Hampshire State Building Code, (IBC 2009), and all local, state fire code Saf-C 6000 county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT

The work of Section 260000 is indicated in this narrative report. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Electrical work and all items incidental thereto, including commissioning and testing.

3. SEQUENCE OF OPERATIONS AND INTERACTIONS

A. Classroom and corridor lighting will be controlled via “addressable relays”, which is achieved through programming. The control of the relays shall be by automatic means such as an occupancy sensor in each classroom

B. Exterior lighting will be controlled by photocell “on” and “schedule” for “off” operation. The vehicle circulation area lighting will be controlled by “zones” and will have dimming-level control.

C. Emergency and exit lighting will be run through life safety panels to be on during normal power conditions as well as power outage conditions.

4. DESCRIPTION OF THE SYSTEMS

A. Electrical Distribution System:

1. New construction service ratings are designed for a demand load of 10 watts/s.f. The service capacity will be sized for 4000 amperes with 100% rating at 277/480 volt, 3Ø, 4wire. New lighting and power panels will be provided to accommodate respective loads. The service capacity will be sized for 20% spare capacity.

B. Interior Lighting System:

1. Classroom lighting fixtures consist of pendant mounted indirect LED luminaries with dimming drivers. The fixtures will be pre-wired for dimming control where natural daylight is available and also for multi-level switching. Office lighting fixtures will consist of similar fixtures to classrooms. Offices on the perimeter

with windows shall have daylight dimming controls**.** In existing building recessed LED fixtures will be used with dimming drivers.

In general lighting power density will be 40 percent less than IECC 2009.

2. Lighting levels will be approximately 30 foot candles in classrooms and offices.

3. Gymnasium lighting will be comprised of direct LED fixtures with dimming drivers. The fixtures will be provided with protective wire guards. The light level will be designed for approximately 50 foot candles.

   Daylight dimming will be provided within 15 feet of skylights or glazing. Daylight dimming controls will be similar in operation to classrooms.

4. Corridor lighting will be comprised of linear indirect lighting using LED light source. The corridor light level will be designed for approximately 15 foot candles. Corridor lighting will be on a schedule through the DDC system control and only “on” during occupied hours. The corridor lighting will have two level control.

5. Cafetorium lighting will be pendant mounted/indirect LED fixtures with dimming drivers. The light levels will be designed for approximately 20 foot candles.

6. Kitchen and Servery lighting will consist of recessed 2 ft. x 2 ft. lensed gasketed LED panels. Light levels will be approximately 50 foot candles.

7. Library lighting will consist of indirect LED fixtures with dimming drivers. Light levels will be approximately 30 foot candles.

8. Each area will be locally switched and designed for multi-level controls. Each classroom, office space and toilet rooms will have an occupancy sensor to turn lights off when unoccupied. Daylight sensors will be installed in each room where natural light is available for dimming of light fixtures.

9. The entire school will be controlled with an automatic lighting control system using the DDC control system for schedule programming of lights.

10. Auditorium lighting will consist of LED cylinders with dimming drivers. The lighting levels will be 20 foot-candles.

C. Emergency Lighting System:

1. An exterior 300 kW natural gas fuelled indoor emergency generator with sound attenuated housing will be provided. Light fixtures and LED exit signs will be installed to serve all egress areas such as corridors, intervening spaces, toilets, stairs and exit discharge exterior doors. The administration area lighting will be connected to the emergency generator.

2. The generator will be sized to include life safety systems, boilers and circulating pumps, communications systems and kitchen refrigeration.

D. Site Lighting System

1. Fixtures for area lighting will be pole-mounted cut-off 'LED' luminaries in the drop-off areas. The fixtures shall be per Town of Brookline standards. Pole heights will be below 12 ft. Fixtures for the underground parking shall be low profile, suspended `LED` fixtures. The exterior lighting will be connected to the automatic lighting control system for photocell on and timed off operation. The site lighting fixtures will be dark sky compliant. The illumination level is 0.5 foot candle minimum for parking areas in accordance with Illuminating Engineering Society.

2. Building perimeter fixtures will be wall mounted cut-off over exterior doors for exit discharge.

E. Wiring Devices:

1. Each classroom will have a minimum of (2) duplex receptacles per teaching wall and (2) double duplex receptacles on dedicated circuits at classroom computer workstations. The teacher's workstation will have a double duplex receptacle also on a dedicated circuit. Refer to drawings.

2. Office areas will generally have (1) duplex outlet per wall. At each workstation a double duplex receptacle will be provided.

3. Corridors will have a cleaning receptacle at approximately 25 foot intervals.

4. Exterior weatherproof receptacles will be installed at exterior doors.

5. A system of computer grade panelboards with double neutrals and transient voltage surge suppressors will be provided for receptacle circuits.

F. Fire Alarm System:

1. A fire alarm and detection system will be provided with 60 battery back-up. The system will be of the addressable type where each device will be identified at the control panel and remote annunciator by device type and location to facilitate search for origin of alarms.

2. Smoke detectors will be provided in open areas, corridors, stairwells and other egress ways.

3. The sprinkler system will be supervised for water flow and tampering with valves.

4. Speaker/strobes will be provided in egress ways, classrooms, assembly spaces, open areas and other large spaces. Strobe only units will be provided in single toilets and conference rooms.

5. Manual pull stations will be provided at exit discharge doors.

6. The system will be remotely connected to automatically report alarms to fire department via an approved method by the fire department.

G. Uninterruptible Power Supply (UPS):

1. Two (2) 30kw, three (3) phase centralized UPS systems will be provided with battery back-up.

2. The system will provide conditioned power to sensitive electronic loads, telecommunication systems, bridge over power interruptions of short duration and allow an orderly shutdown of servers, communication systems, etc. during a prolonged power outage.

3. The UPS systems will also be connected to the stand by generator.

H. Lightning Protection System:

1. A system of lightning protection devices will be provided.

2. The lightning protection equipment will include air terminals, conductors, conduits, fasteners, connectors, ground rods, etc.

5. TESTING REQUIREMENTS

The Electrical Contractor shall provide testing of the following systems with the Owner and Owner's representative present:

- Lighting and power panels for correct phase balance.
- Emergency generator.
- Lighting control system (interior and exterior).
- Fire alarm system.
- Security system.
- Lightning protection system.

Testing reports shall be submitted to the engineer for review and approval before providing to the Owner.

6. OPERATION MANUALS AND MAINTENANCE MANUALS:

When the project is completed, the Electrical Contractor shall provide operation and maintenance manuals to the Owner.

7. RECORD DRAWINGS AND CONTROL DOCUMENTS:

When the project is completed, an as-built set of drawings, showing all lighting and power requirements from contract and addendum items, will be provided to the Owner.

8. COMMISSIONING

The project shall be commissioned per Section 018000 of the specifications.

9. RENEWABLE ENERGY PROVISIONS

Provisions for a renewable energy system will consist of a grid connected photovoltaic PV system intended to reduce the facilities demand for electricity. The photovoltaic system will be provided under a separate contract.

10. SITE UTILITIES

The Electric, Telephone and Cable TV utilities will be underground for each system provided.

11. CCTV

A Closed Circuit TV system will consist of computer servers with image software, computer monitors and IP based closed circuit TV cameras. The head end server will be located in the head end (MDF) room and will be rack mounted. The system can be accessed from any PC within the facility or externally via an IP address. Each camera can be viewed independently. The network video recorders (SAN) will record all cameras and store this information for 45 days at 30 images per second (virtual real time).

The location of the cameras is generally in corridors and exterior building perimeter. The exterior cameras are pan-tilt-zoom type.

The system will fully integrate with the access control system to allow viewing of events from a single alarm viewer. Camera images and recorded video will be linked to the access system to allow retrieval of video that is associated with an event.

12. INTRUSION SYSTEM

An intrusion system will consists of security panel, keypads, motion detectors and door contacts. The system is addressable which means that each device will be identified when an alarm occurs. The system is designed so that each perimeter classroom with grade access will have dual tech sensors along the exterior wall and corridors, door contacts at each exterior door.

The system can be partitioned into several zones. Therefore, it is possible to use the Gym area while the remainder of the school remains alarmed.

The system will include a digital transmitter to summons the local police department in the event of an alarm condition

The intrusion system will be connected to the automated lighting control system to automatically turn on lighting upon an alarm.

13. CARD ACCESS

A card access system includes a card access controller, door controllers and proximity readers/keypads. Proximity readers will be located at various locations. Each proximity reader will have a distinctive code to identify the user and a log will be kept in memory. The log within the panel can be accessed through a computer.

The alarm condition will also initiate real time recording on the integrated CCTV System. The system may be programmed with graphic maps allowing the end-user to quickly identify alarm conditions and lock/unlock doors.

The system is modular and may be easily expanded to accommodate any additional devices.

14. PHASING

The new electrical service will be constructed under Phase 1 and back feed existing equipment.

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47923/Page 1/May 15, 2015

PLUMBING SYSTEMS NARRATIVE REPORT

OPTION 2B – RENOVATION / ADDITION

The following is the Plumbing system narrative, which defines the scope of work and capacities of the Plumbing system as well as the Basis of Design. The Plumbing Systems shall be designed and constructed for ***LEED for Schools*** where indicated on this narrative.

1. CODES

   A. All work installed under Section 220000 shall comply with the NH Building Code, MA Plumbing Code and all state, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT

   A. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Plumbing work and all items incidental thereto, including commissioning and testing.

3. GENERAL

   A. The Plumbing Systems that will serve the project are cold water, hot water, tempered water, sanitary waste and vent system, grease waste system, special waste system, storm drain system, natural gas and compressed air.

   B. The Building will be serviced by Municipal water and Municipal sewer system.

   C. All Plumbing in the building will conform to Accessibility Codes and to Water Conserving sections of the Plumbing Code.

4. DRAINAGE SYSTEM

   A. Soil, Waste, and Vent piping system is provided to connect to all fixtures and equipment. System runs from 10 feet outside building and terminates with stack vents through the roof.

   B. A separate Grease Waste System starting with connection to an exterior concrete grease interceptor running thru the new kitchen and servery area fixtures and terminating with a vent terminal through the roof. Point of use grease interceptors are to be provided at designated kitchen fixtures. The grease interceptor is provided under Division 33 scope.

   C. Storm Drainage system is provided to drain all roofs with roof drains piped through the building to a point 10 feet outside the building.

   D. Drainage system piping will be service weight cast iron piping; hub and spigot with gaskets for below grade; no hub with gaskets, bands and damps for above grade 2 in. and larger. Waste and vent piping 1-1/2 in. and smaller will be type ‘L’ copper.

E. A separate Special Waste System shall be provided starting with a connection to an interior limestone chip acid neutralizer, running thru the building to collect science classroom fixtures and terminating with vent terminals through the roof. Special Waste and Vent piping will be Schedule 40 electric heat fused polypropylene piping, fittings and traps, flame retardant above grade and non-flame retardant below ground.

5. WATER SYSTEM

A. New 6 inch domestic water service from the municipal water system will be provided to the building addition. A meter and backflow preventer, if required, will be provided. New water distribution will be provided from the addition to the existing building.

B. Cold water distribution main is provided. Non-freeze wall hydrants with integral back flow preventers are provided along the exterior of the building.

C. Domestic hot water heating will be provided with a combination of gas fired, high efficiency, and condensing water heaters with separate storage tank. System is to be equipped with thermostatically controlled mixing devices to control water temperature to the fixtures.

D. A pump will re-circulate hot water from the piping system. Water temperature will be 120 deg. to serve general use fixtures. A 140 deg. F hot water will be supplied to the kitchen dishwasher.

E. Water piping will be type 'L' copper with wrot copper sweat fittings, silver solder or press-fit system. All piping will be insulated with 1 in. thick high density fiberglass.

6. GAS SYSTEM

A. Natural gas service will be provided for the building and will serve the boilers, domestic water heaters, kitchen cooking equipment, roof top equipment and generator.

B. Gas piping will be Schedule 40 black steel pipe with threaded gas pattern malleable fittings for 2 in. and under and butt welded fittings for 2-1/2 in. and larger.

7. COMPRESSED AIR SYSTEM

A. Compressed air will be provided for the vocational shop areas.

B. Compressed air piping will be Schedule 40 black steel pipe with threaded gas pattern malleable fittings.

8. FIXTURES ***LEED for Schools Credit WEp1 & WEc3***

A. Furnish and install all fixtures, including supports, connections, fittings, and any incidentals to make a complete installation.

B. Fixtures shall be the manufacturer's guaranteed label trademark indicating first quality. All acid resisting enameled ware shall bear the manufacturer's symbol signifying acid resisting material.

C. Vitreous china and acid resisting enameled fixtures, including stops, supplies and traps shall be of one manufacturer by Kohler, American Standard, or Eljer, or equal. Supports shall be Zurn, Smith, Josam, or equal. All fixtures shall be white. Faucets shall be Speakman, Chicago, or equal.

D. Fixtures shall be as scheduled on drawings.

1. Water Closet: High efficiency toilet, 1.28 gallon per flush, wall hung, vitreous china, siphon jet. Manually operated 1.28 gallon per flush-flush valve.

2. Urinal: High efficiency 0.13 gallon per flush urinal, wall hung, vitreous china. Manually operated 0.13 gallon per flush-flush valve.

3. Lavatory: Wall hung/countertop ADA lavatory with 0.5 GPM metering mixing faucet programmed for 10 second run-time cycle.

4. Sink: Elkay ADA stainless steel countertop sink with Chicago 201A faucet and 0.5 GPM aerator.

5. Drinking Fountain: Halsey Taylor hi-low wall mounted electric water cooler, stainless steel basin with bottle filling stations.

6. Janitor Sink: 24 x 24 x 10 Terrazo mop receptor Stern-Williams or equal.

7. Laboratory Sinks: Faucets with vacuum breakers and 0.74 GPM aerators.

9. DRAINS

A. Drains are cast iron, caulked outlets, nickaloy strainers, and in waterproofed areas and roofs shall have galvanized iron clamping rings with 6 lb. lead flashings to bond 9 in. in all directions. Drains shall be Smith, Zurn, Josam, or equal.

10. VALVES

A. Locate all valves so as to isolate all parts of the system. Shutoff valves 3 in. and smaller shall be ball valves, solder end or screwed, Apollo, or equal.

11. INSULATION

A. All water piping shall be insulated with snap-on fiberglass insulation Type ASJ-SSL, equal to Johns Manville Micro-Lok HP.

12. CLEANOUTS

A. Cleanouts shall be full size up to 4 in. threaded bronze plugs located as indicated on the drawings and/or where required in soil and waste pipes.

B. Cleanouts for Special Waste System shall be Zurn #Z9A-C04 polypropylene cleanout plug with Zurn #ZANB-1463-VP nickel bronze scoriated floor access cover.

13. ACCESS DOORS

A. Furnish access doors for access to all concealed parts of the plumbing system that require accessibility. Coordinate types and locations with the Architect.

14. WATER HEATER

A. Gas fired, high efficiency, condensing water heaters with separate storage tank.

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47919/Page 1/May 15, 2015

FIRE PROTECTION SYSTEMS NARRATIVE REPORT

OPTION 2B – RENOVATION / ADDITION

The following is the Fire Protection system narrative, which defines the scope of work and capacities of the Fire Protection system as well as the Basis of Design.

1. CODES

   A. All work installed under Section 210000 shall comply with the NH Building Code and all state, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT

   A. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Fire Protection work and all items incidental thereto, including commissioning and testing.

3. DESCRIPTION

   A. The existing building to remain is currently protected with an automatic sprinkler system. This system will be maintained and modified to protect renovated areas.

   B. The building addition will be served by a new 8 inch fire service, double check valve assembly, wet alarm valve complete with electric bell, and fire department connection meeting local thread standards.

   B. System will be a combined standpipe/sprinkler system with control valve assemblies to limit the sprinkler area controlled to less than 52,000 s.f. as required by NFPA 13-2013.

   C. Control valve assemblies shall consist of a supervised shutoff valve, check valve, flow switch and test connection with drain. Standpipes meeting the requirements of NFPA 14-2013 shall be provided in the Stage area.

   D. All areas of the building, including all finished and unfinished spaces, combustible concealed spaces, all electrical rooms and closets will be sprinklered.

   E. All sprinkler heads will be quick response, pendent in hung ceiling areas and upright in unfinished areas.

   F. Fire department valves and cabinets will be provided on each side of the Stage in the Building.

5. BASIS OF DESIGN

   A. The mechanical rooms, kitchen, science classrooms, and storage rooms are considered Ordinary Hazard Group 1; stage and vocational shops considered Ordinary Hazard Group 2; all other areas are considered light hazard.

B. Required Design Densities:

Light Hazard Areas	0.10 GPM over 1,500 s.f.
Ordinary Hazard Group 1	0.15 GPM over 1,500 s.f.
Ordinary Hazard Group 2	0.20 GPM over 1,500 s.f.

C. Sprinkler spacing (max.):

Light Hazard Areas:	225 s.f.
Ordinary Hazard Areas:	130 s.f.

D. A flow test will be required to be performed to confirm the Municipal water supply.

6. PIPING

A. Sprinkler piping 1-1/2 in. and smaller shall be ASTM A-53, Schedule 40 black steel pipe. Sprinkler/standpipe piping 2 in. and larger shall be ASTM A-135, Schedule 10 black steel pipe.

7. FITTINGS

A. Fittings on fire service piping, 2 in. and larger, shall be Victaulic Fire Lock Ductile Iron Fittings conforming to ASTM A-536 with integral grooved shoulder and back stop lugs and grooved ends for use with Style 009-EZ or Style 005 couplings. Branch line fittings shall be welded or shall be Victaulic 920/920N Mechanical Tees. Schedule 10 pipe shall be roll grooved. Schedule 40 pipe, where used with mechanical couplings, shall be roll grooved and shall be threaded where used with screwed fittings. Fittings for threaded piping shall be malleable iron screwed sprinkler fittings.

8. JOINTS

A. Threaded pipe joints shall have an approved thread compound applied on male threads only. Teflon tape shall be used for threads on sprinkler heads. Joints on piping, 2 in. and larger, shall be made up with Victaulic, or equal, Fire Lock Style 005, rigid coupling of ductile iron and pressure responsive gasket system for wet sprinkler system as recommended by manufacturer.

9. DOUBLE CHECK VALVE ASSEMBLY

A. Double check valve assembly shall be New Hampshire State approved, U.L./F.M. approved, with iron body bronze mounted construction complete with supervised OS & Y gate valves and test cocks. Furnish two spare sets of gaskets and repair kits.

B. Double check valve detector assembly shall be of one of the following:

1. Watts Series 757-OSY
2. Wilkins 350A-OSY
3. Conbraco Series 4S-100
4. Or equal

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47908/Page 1/May 15, 2015

TECHNOLOGY SYSTEMS NARRATIVE REPORT

OPTION 2B – ADDITION / RENOVATION

The following is the Technology System narrative, which defines the scope of work and capacities of the Communications system infrastructure and Security system as well as the Basis of Design.

1. CODES

   A. All work installed under Section 270000 shall comply with the New Hampshire Building Code, IBC 2009, and all local, county, and federal codes, laws, statues, and authorities having jurisdiction.

2. DESIGN INTENT

   A. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Technology and Security work and all items incidental thereto, including commissioning and testing.

3. TECHNOLOGY

   A. The data system infrastructure will consist of fiber optic backbone cabling horizontal wiring will consist of Category 6A UTP Plenum rated cabling for both data and telephone systems for gigabit connectivity. The telephone infrastructure will accommodate PBX, or VOIP based voice systems. A new IP telephone system will be used.

   B. Each classroom will have 4 data outlets for student computers. Two data, one voice with video and audio connections to a wall-mounted interactive projector or touchscreen will be provided at teacher's station with interconnectivity to a interactive whiteboard. A wall phone outlet with 2 way ceiling speaker will be provided for communications with administration. Wireless access points will be provided in all classrooms and other spaces in addition to (2) CAT6A.cables to access points multimode fiber will also be provided.

   C. A central paging system will be provided and integrated with the telephone system. The paging speakers will be IP.

   D. A wireless GPS/LAN based master clock system will be provided with 120V wireless remote clocks that act as transceivers.

   E. The Main Distribution Frame (MDF) will contain all core network switching and IP voice switch. Intermediate Distribution Frames (IDFs) will serve each floor/wing of the school. A fiber optic backbone will be provided from each IDF to MDF. The backbone will be designed for 10 Gbps Ethernet.

4. TESTING REQUIREMENTS

A. The Technology and Security Contractors shall provide testing of the following systems with the Owner and Owner's representative present:

- Telephone and data cabling
- Fiber optic backbone cabling
- Paging system
- Wireless clock system
- A/V wiring for classrooms

Testing reports shall be submitted to the engineer for review and approval before providing to the Owner.

5. OPERATION MANUALS AND MAINTENANCE MANUALS:

A. When the project is completed, the Technology Contractor shall provide operation and maintenance manuals to the Owner.

6. RECORD DRAWINGS AND CONTROL DOCUMENTS:

A. When the project is completed, an as-built set of drawings, showing all lighting and power requirements from contract and addendum items, will be provided to the Owner.

7. COMMISSIONING

A. The project shall be commissioned per Commissioning Section of the specifications.

8. PHASING

A. The existing telephone, internet and cable-TV services will not be impacted by phasing. A new head end room will be constructed as part of the addition. New IDF closets will be provided in the area being renovated.

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47907/Page 1/May 15, 2015

HVAC SYSTEMS NARRATIVE REPORT

OPTIONS 3B & 3D - NEW CONSTRUCTION

The following is the HVAC system narrative, which defines the scope of work and capacities of the HVAC system as well as the Basis of Design. The HVAC systems shall be designed and constructed for ***LEED for Schools*** where indicated on this narrative.

1. CODES:

   All work installed under Division 230000 shall comply with the State of New Hampshire Building Code and all local, IBC 2012, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT:

   The work of Division 230000 is described within the narrative report. The HVAC project scope of work shall consist of providing new HVAC equipment and systems as described here within. All new work shall consist of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Heating, Ventilating and Air Conditioning work and all items incidental thereto, including commissioning and testing.

3. BASIS OF DESIGN:

   Project weather and Code temperature values are listed herein based on weather data values as determined from ASHRAE weather data tables and the International Energy Conservation Code.

   Outside: Winter -2 deg. F, Summer 88 deg. F DB 73 deg. F WB

   Inside: 70 deg. F +/- 2 deg F for heating, 75 deg. F +/- 2 deg F (55% RH) for cooling for areas with air conditioning, 78 deg. F +/- 2 deg. F (<60% RH) for areas with displacement/dehumidification*(see Displacement Ventilation note below). Unoccupied temperature setback will be provided (60 deg F heating (adj.), 85 deg F cooling/dehumidification (adj.).

   Outside air shall be provided at the rate in accordance with ASHRAE guide 62.1-2010 and the International Mechanical Code as a minimum. All occupied areas will be designed to maintain 800 PPM carbon dioxide maximum.

4. SYSTEM DESCRIPTION:

   A. Central Heating Plants: ***LEED for Schools Credit EP2 & EC1***

      Heating for the entire building will be through the use of a high efficiency gas-fired condensing boiler plant.

      The new boiler plant shall be provided with (4) 2,500 MBH output boilers and (2) end suction base mounted primary and standby pumps with a capacity of 680 gpm each will be located in the mechanical room. Boilers shall each be sized for approximately 33% of the building radiation heating load. In addition to new boilers and pumps, new hot water accessories including air separators and expansion tanks shall be provided.

The boiler plant will supply heating hot water to heating equipment and systems located throughout the building through a two-pipe fiberglass insulated schedule 40 black steel and copper piping system. The boiler plants shall supply a maximum hot water temperature of 160 deg F on a design heating day and the hot water supply water temperature will be adjusted downward based on an outside temperature reset schedule to improve the overall operating efficiency of the power plants. Primary and standby end suction base mounted pumps will be provided with variable frequency drives for variable volume flow through the water distribution system for improved energy efficiency.

Combustion air for each boiler will be directly ducted to each boiler through a galvanized ductwork distribution system. Venting from each boiler shall be through separate double wall aluminized stainless steel (AL29-4C) vent system and shall discharge approximately 12 feet above the roof level. Final venting height will be depending on the location of building intake air locations and adjacent roofs.

B. Central Cooling Plant: ***LEED for Schools Credit EP2 & EC1***

A high efficiency central chilled water cooling plant consisting of a 50 ton high efficiency air cooled chilled, primary and standby chilled water pumps with VFDs, each with a capacity of 110 gpm, accessories, controls and steel and copper piping distribution system shall be provided to serve chilled water cooling HVAC equipment located throughout the building. The chilled water system will consist of a 35% propylene glycol solution. A glycol make-up feed unit system shall be provided.

The chiller plant shall serve active chilled beam induction units located in the Administration, Town Square, Forum areas of the building and select classrooms that require full air conditioning.

C. Classroom Heating and Ventilation *(General Classrooms, Learning Commons, Science, Art, SPED, Cosmetology, Computer Tech/Programming, Life, Health and Family Cons Science)**:***
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

It is proposed that new displacement ventilation systems are installed to serve the Building classroom areas under this Option.

New air handling units with supply and return fan with VFDs, energy recovery wheels, gas fired heating and DX cooling with modulating capacity control, sensible reheat wheel or heat pipe, and MERV 13 filtration will be provided to serve the new displacement ventilation system. Supply air will be provided to the space through new insulated, galvanized steel supply duct distribution system and shall be connected to wall mounted displacement ventilation diffusers located within the classrooms. Return air will be drawn back to the units by ceiling return air registers located within the classroom and will be routed back to the air handling unit by an insulated galvanized sheetmetal return air ductwork distribution system. Supplemental hot water fin tube radiation or ceiling radiant heating will be provided along exterior walls.

Each classroom will be provided with a variable air volume terminal box and CO2 sensor for demand ventilation control.

It is estimated that the following air handling equipment will be required to serve these Classroom areas:

RTU-1, 2, 3, 4, 5 & 6: Six (6) rooftop air handling units with a capacity of 12,000 CFM (42.5 tons cooling, 530 MBH heating output) each, to serve the three main classroom wings.

RTU-7: One (1) rooftop air handling unit with a capacity of 4,500 CFM (17.5 tons cooling, 200 MBH heating output) to serve the Business and SPED classrooms.

RTU-8: One (1) rooftop air handling unit with a capacity of 8,000 CFM (30 tons cooling, 350 MBH heating output) to serve the Computer Technology & Programming, Life Science, Health Sciences and Family Cons. Sciences Classroom areas.

Displacement Ventilation:

The displacement ventilation system for the classroom wings are intended to provide a maximum cooling temperature during peak cooling periods of approximately 78°F ± 2°F, however, the ventilation air provided will be extremely dry which will be the result of utilizing refrigeration equipment and hot gas reheat to reduce vapor pressure to an extremely low condition of approximately 50 grains of moisture per pound of air and reheating the air to a supply temperature of approximately 68°F which will be distributed to each space. The extremely dry condition of the supply air provides the perception of a condition that is cooler than is actually occurring due to the evaporation of moisture to the adjacent air from the occupants of the space.

Considering maximum cooling requirements occur primarily during the months of July and August when the majority of the academic areas are not in use, it would suggest maintaining slightly higher temperatures may not present a discomfort, however, will relate to a substantial operating cost savings and a reduced installation cost.

An additional major benefit of utilizing dry air within the building will be the overall reduction of vapor pressure typically present in outside ventilation air during summer months. This reduction in vapor pressure will dramatically reduce the amount of moisture entering the building and the potential of condensation resulting in moisture, and a direct relationship with the formation of mold.

Classrooms Requiring Full Air Conditioning:

Classrooms that require full air conditioning will be provided with supplemental cooling active chilled beam induction units.

D. Gymnasium:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-9&10: The gymnasium will be served by two (2) air-handling unit of the recirculation design. The unit will be approximately 6,500 CFM and will include supply and return fans with VFDs, 320 MBH output gas-fired heating and 22 Tons DX cooling with modulating capacity control, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an exposed galvanized steel supply duct with drum louvers to project the air to the floor. As levels of carbon dioxide drop generally relating to a

reduction in population a variable frequency drive located in each air-handling unit will modulate to reduce airflow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the air handling unit by a low wall return air register.

E. Alternate PE:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-11: The Alternate PE area will be served by a rooftop air-handling unit of the recirculation design. The unit will be approximately 2,500 CFM and will include supply and return fans with VFDs, 130 MBH output gas fired heating and 7.5 Ton DX cooling with modulating capacity control, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an exposed galvanized steel supply duct with drum louvers to project the air to the floor. As levels of carbon dioxide drop generally relating to a reduction in population a variable frequency drive located in each air-handling unit will modulate to reduce airflow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the air-handling unit by a low wall return air register.

F. Fitness Room:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-12: The Fitness area will be served by an rooftop air-handling unit of the recirculation design. The unit will be approximately 2,000 CFM and will include supply and return fans with VFDs, 120 MBH output heating and 6.5 Ton DX cooling with modulating capacity control, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an exposed galvanized steel supply duct with drum louvers to project the air to the floor. As levels of carbon dioxide drop generally relating to a reduction in population a variable frequency drive located in each air-handling unit will modulate to reduce airflow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the air-handling unit by a low wall return air register.

G. Locker Rooms:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

RTU-13 & RTU-14: The Boys and Girls locker rooms, and adjacent PE office areas will be provided with new roof-mounted air handling units of the 100% outside air design with energy recovery. There will be (2) units, with one unit serving the Boy's locker room areas and the other unit serving the Girl's locker room areas. Both units will be approximately 3,200 CFM and will include a supply and exhaust fan with VFDs, 200 MBH output gas fired heating section with modulating capacity control, DX cooling for dehumidification and MERV 13 filtration. Supply air ventilation will be provided to each space through new galvanized supply duct which will travel throughout each locker room area to a series of ceiling mounted supply registers. New exhaust air ductwork and air distribution devices shall be installed and shall be routed from the locker and team rooms to the new air handling units.

H. Auditorium and Stage:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

The auditorium and stage will be provided with new roof-mounted air handling units of the recirculation design capable of providing 100% outside air variable volume displacement ventilation air distribution to the Auditorium and Stage areas.

RTU-15: The Auditorium unit will be approximately 10,000 CFM and will include supply and return fans with VFDs, 480 MBH output gas fired heating section with modulating capacity control, 35 ton DX cooling system and MERV 13 filtration.

RTU-16: The stage unit will be approximately 4,000 CFM and will include supply and return fans with VFD's, 180 MBH gas-fired heating section with modulating capacity control, 10 ton DX cooling system and MERV 13 filtration.

Supply air ventilation to the auditorium will be provided to the space through a galvanized steel supply duct distribution system that will connect to displacement diffusers under the seating. In addition, carbon dioxide controls will be installed which will monitor the overall level of carbon dioxide at a threshold level of 800 ppm. As levels drop generally relating to a reduction in population the air handling unit outside air damper will modulate to reduce air flow and ventilation while always maintaining a maximum of 800 ppm. Return air will be drawn back to the units by return air registers located high on walls within the space or near the ceiling of the space.

I. Music/Chorus/Band/Practice rooms***:***
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

It is proposed that new displacement ventilation systems are installed to serve the Music, Chorus, Band and Practice classroom areas under this Option.

A rooftop air handling unit with supply and return fan with VFDs, energy recovery wheels, gas fired heating and DX cooling with modulating capacity control, sensible reheat wheel or heat pipe, and MERV 13 filtration will be provided to serve the new displacement ventilation system. Supply air will be provided to the space through new insulated, galvanized steel supply duct distribution system and shall be connected to wall mounted displacement ventilation diffusers located within the classrooms. Return air will be drawn back to the units by ceiling return air registers located within the classroom and will be routed back to the air handling unit by an insulated galvanized sheetmetal return air ductwork distribution system. Supplemental hot water fin tube radiation or ceiling radiant heating will be provided along exterior walls.

Each classroom will be provided with a variable air volume terminal box and CO2 sensor for demand ventilation control.

It is estimated that the following air handling equipment will be required to serve these Classroom areas:

RTU-17: One (1) rooftop air handling unit with a capacity of 3,500 CFM (15 tons cooling, 200 MBH heating output).

J. Administration Areas (HS, CTC & Marketing):
LEED for Schools Credit EO2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

Spatial heating and air-conditioning for the HS, CTC Administration area, Marketing and Guidance offices will be served by horizontal ceiling concealed type ducted 4-pipe heating and cooling active chilled beam induction units with hot water and chilled water for the induction unit system provided by the individual hot water and chilled water central recirculation piping system communicating with the boiler and chilled water power plants.

RTU-18: The ventilation rooftop air handling will serve the Administration office areas and the Town Square and Forum areas of the building. The unit capacity will be approximately 12,500 CFM and will include supply and return fan with VFDs, 550 MBH output gas fired heating section with modulating capacity control, MERV 13 filtration, 35 ton capacity DX cooling section, and exhaust air energy recovery wheel. Supply air ventilation will be provided to each space that will satisfy building code requirements based on population.

K. Town Square/Forum:
LEED for Schools Credit EP2, EC1, EC5, IEQP1, IEQC1, 2, 3.1, 3.2, 5, 6.2 & 7.1

Spatial heating and air-conditioning for the Town Square and Forum area will be served by horizontal ceiling concealed type ducted 4-pipe heating and cooling active chilled beam induction units with hot water and chilled water for the induction unit system provided by the individual hot water and chilled water central recirculation piping system communicating with the boiler and chilled water power plants.

RTU-18: Please refer to Administration Area RTU description.

L. Kitchen:
LEED for Schools Credit EP2

The kitchen area shall be provided with new kitchen exhaust air fan and make-up air handling unit with hot water heating. The kitchen will be heated by a heating and ventilation air-handling units with gas fired heating, MUA-1 unit.

A variable volume kitchen exhaust hood control system consisting of kitchen exhaust stack temperature and smoke density sensors, supply and exhaust fan variable speed drives and associated controller will be provided by the kitchen equipment vendor. This system installation shall be field installed and coordinated with the ATC and Electrical contractors.

M. Culinary:
LEED for Schools Credit EP2

The Culinary area shall be provided with new kitchen exhaust air fan and make-up air handling unit with hot water heating. The kitchen will be heated by a heating and ventilation air-handling units with gas-fired heating, MUA-2 unit.

A variable volume kitchen exhaust hood control system consisting of kitchen exhaust stack temperature and smoke density sensors, supply and exhaust fan variable speed drives and associated controller will be provided by the kitchen equipment vendor. This

system installation shall be field installed and coordinated with the ATC and Electrical contractors.

N. Wood Shop:

RTU-19: The wood shop will be provided with a gas fired roof mounted air handling unit of 100% outside air design. The unit will have a capacity of 6,000 CFM with 300 MBH output heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the wood shop will be a fully engineered dust collection system with all associated controls, filters, rotary valves and safety features such as explosion proof motors and fire extinguishing device located within the ductwork. Blast gates will also be provided for each piece of equipment. All ductwork shall be designed for high velocity systems with gasket locked connections. The system shall have a capacity of approximately 6000 cfm. A typical manufacture of this system would be Donaldson Torit, model DFO.

The system shall be equipped with a listed spark detection system locate down the duct upstream of the collector and downstream from the last material entry point. A high speed abort gate activated by the spark detector shall divert any burning material to atmosphere before it can enter the building. The abort gate shall have a manual reset so that after it has aborted, it can be reset to the normal position. A typical manufacture of this system would be GreCon, model RBS-2.

O. Welding Shop / Pre-Engineering:

RTU-20: The Welding shop and Pre-Engineering Shop will be provided with a gas fired roof mounted air handling unit of the 100% outside air design. The unit will have a capacity of 6,000 CFM with 300 MBH output heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 1000 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the welding shop will be welding boots which will require the appropriate exhaust systems. Each welding station will be provided with its own separate exhaust drop for individual exhaust air capture. Two exhaust fans at approximately 1500 cfm each.

P. Auto Technology Shop:

RTU-21: The Auto Technology shop will be provided with a gas fired roof mounted air-handling unit of the 100% outside air design. The unit will have a capacity of 3,500 CFM with 200 MBH output heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 1000 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the shop will be a fully engineered vehicle capture exhaust system which will be utilized to capture the exhaust fumes of the small engines during start up procedures or demonstrations. The system will have an approximate capacity of 2000 CFM and will consist of explosion proof motors.

Q. Auto Body Collision Shop:

RTU-22: The Auto Body Collision shop will be provided with a gas fired roof mounted air-handling unit of the 100% outside air design. The unit will have a capacity of 8,000 CFM with 400 MBH output of heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 1000 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the shop will be a fully engineered vehicle capture exhaust system which will be utilized to capture the exhaust fumes of the engines during start up procedures or demonstrations. The system will have an approximate capacity of 5000 CFM and will consist of explosion proof motors.

A paint booth will also be located within the shop area and will be provided with a packaged exhaust system with explosion proof motors sized at an approximate capacity of 12,000 cfm. To maintain neutral pressure within the space once the exhaust systems are activated the paint booth will be provided with its own dedicated make up air unit, MAU-3, to maintain a neutral pressure within the paint booth. The paint booth will operate as its own independent system rather than interlocking it with the shops air handling unit. This will prevent oversizing of the shops unit and consume less energy.

R. Building Technology Shop:

RTU-23: The Building Technology shop will be provided with a gas fired roof mounted air handling unit of 100% outside air design. The unit will have a capacity of 6,000 CFM with

300 MBH output of heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

Also located within the wood shop will be a fully engineered dust collection system with all associated controls, filters, rotary valves and safety features such as explosion proof motors and fire extinguishing device located within the ductwork. Blast gates will also be provided for each piece of equipment. All ductwork shall be designed for high velocity systems with gasket locked connections. The system shall have a capacity of approximately 4000 cfm. A typical manufacture of this system would be Donaldson Torit, model DFO.

The system shall be equipped with a listed spark detection system locate down the duct upstream of the collector and downstream from the last material entry point. A high speed abort gate activated by the spark detector shall divert any burning material to atmosphere before it can enter the building. The abort gate shall have a manual reset so that after it has aborted, it can be reset to the normal position. A typical manufacture of this system would be GreCon, model RBS-2.

S. Electrical Shop:

RTU-24: The Building Technology shop will be provided with a gas fired roof mounted air handling unit of 100% outside air design. The unit will have a capacity of 6,200 CFM with 300 MBH of heating capacity. The unit will include a supply fan, exhaust fan, energy recovery wheel, gas fired furnace with modulating gas valve, MERV 13 filtration, and carbon dioxide controls which will reduce outside air as allowed and maintaining a maximum of 800 PPM. Supply air ventilation will be provided to the space through an overhead galvanized supply air distribution system. Return air will be delivered back to the rooftop unit via a galvanized return air duct distribution system connected to low wall return air registers. As levels of carbon dioxide drop generally relating to a reduction in population, the rooftop unit's outside air damper will modulate to reduce outside air flow ventilation while always maintaining a maximum of 1000 ppm and room temperature and humidity set points.

T. Lobby, Corridor, and Entry Way Heating:

New hot water convectors, cabinet unit heaters and fin tube radiation heating equipment shall be installed to provide heating to these areas. Corridors shall be ventilated from adjacent air handling unit systems.

U. Custodial Support Areas:

HVU-1: Custodial support areas will be heated and ventilated by a heating and ventilation unit with an estimated capacity of 1,800 CFM. Storage areas will be heated by

radiation heating equipment. Horizontal type unit heaters will heat areas adjacent to the loading dock. All custodial closets will be exhausted by exhaust air fan systems.

V. Utility Areas:

Utility areas will be provided with exhaust air fan systems for ventilation, and will typically be heated with horizontal type ceiling suspended unit heaters.

The main IDF room will be air conditioned by high efficiency ductless AC cooling units.

W. Testing, Adjusting, Balancing & Commissioning:

All new HVAC systems shall be tested, adjusted, balanced and commissioned as part of the project scope.

X. Automatic Temperature Controls – Building Energy Management System

A new DDC (direct digital control) automatic temperature control and building energy management system shall be installed to control and monitor building HVAC systems. Energy metering shall be installed to monitor the energy usage of building HVAC systems and utilities (fuel, gas, water).

The control system shall be as manufactured by Johnson Controls, Honeywell, Siemens or Equal.

5. TESTING REQUIREMENTS:

A. The mechanical contractor shall provide testing of the following systems with the owner and owner's representative present:

1. Boiler plant system

2. Chilled water plant system

3. Air handling unit systems including all rooftop units, indoor air handling systems and exhaust air systems

4. Terminal heating and cooling devices

5. Automatic temperature control and building energy management system

B. Testing reports shall be submitted to the engineer for review and approval before providing to the owner.

6. OPERATION MANUALS AND MAINTENANCE MANUALS: When the project is completed, the mechanical contractor shall provide operation and maintenance manuals to the owner.

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47907/Page 11/May 15, 2015

7. RECORD DRAWINGS AND CONTROL DOCUMENTS: When the project is completed, an as-built set of drawings, showing all mechanical system requirements from contract and addendum items will be provided to the owner.

8. COMMISSIONING: The project shall be commissioned per Section 018000 of the specifications.

Dover High School and Technical Career Center
Dover, NH
J#831 044 00.00
L#47900/Page 1/May 15, 2015

ELECTRICAL SYSTEMS NARRATIVE REPORT

OPTIONS 3B & 3D - NEW CONSTRUCTION

The following is the Electrical system narrative, which defines the scope of work and capacities of the Power and Lighting system as well as the Basis of Design. The electrical systems shall be designed and constructed for ***LEED Version 4*** where indicated on this narrative. This project shall confirm to LEED Silver rating.

1. CODES

All work installed under Division 26 shall comply with the New Hampshire State Building Code, (IBC 2009), and all local, state fire code Saf-C 6000, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT

The work of Section 260000 is indicated in this narrative report. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Electrical work and all items incidental thereto, including commissioning and testing.

3. SEQUENCE OF OPERATIONS AND INTERACTIONS

A. Classroom and corridor lighting will be controlled via “addressable relays”, which is achieved through programming. The control of the relays shall be by automatic means such as an occupancy sensor in each classroom.

B. Exterior lighting will be controlled by photocell “on” and “schedule” for “off” operation. The vehicle circulation area lighting will be controlled by “zones” and will have dimming-level control.

C. Emergency and exit lighting will be run through life safety panels to be on during normal power conditions as well as power outage conditions.

4. DESCRIPTION OF THE SYSTEMS

A. Electrical Distribution System:

1. New construction service ratings are designed for a demand load of 10 watts/s.f. The service capacity will be sized for 4000 amperes with 100% rating at 277/480 volt, 3Ø, 4wire. New lighting and power panels will be provided to accommodate respective loads. The service capacity will be sized for 20% spare capacity.

B. Interior Lighting System:

1. Classroom lighting fixtures consist of pendant mounted indirect LED luminaries with dimming drivers. The fixtures will be pre-wired for dimming control where natural daylight is available and also for multi-level switching. Office lighting fixtures will consist of similar fixtures to classrooms. Offices on the perimeter

with windows shall have daylight dimming controls**.** In existing building recessed LED fixtures will be used with dimming drivers.

In general lighting power density will be 40 percent less than IECC 2009.

2. Lighting levels will be approximately 30 foot candles in classrooms and offices.

3. Gymnasium lighting will be comprised of direct LED fixtures with dimming drivers. The fixtures will be provided with protective wire guards. The light level will be designed for approximately 50 foot candles.

   Daylight dimming will be provided within 15 feet of skylights or glazing. Daylight dimming controls will be similar in operation to classrooms.

4. Corridor lighting will be comprised of linear indirect lighting using LED light source. The corridor light level will be designed for approximately 15 foot candles. Corridor lighting will be on a schedule through the DDC system control and only “on” during occupied hours. The corridor lighting will have two level control.

5. Cafeteria lighting will be pendant mounted/indirect LED fixtures with dimming drivers. The light levels will be designed for approximately 20 foot candles.

6. Kitchen and Servery lighting will consist of recessed 2 ft. x 2 ft. lensed gasketed LED panels. Light levels will be approximately 50 foot candles.

7. Library lighting will consist of indirect LED fixtures with dimming drivers. Light levels will be approximately 30 foot candles.

8. Auditorium theatrical lights with a dimming system will be provided for performances. House lighting in auditorium will be dimmable fluorescent and controlled by theatrical house dimming system. Theatrical border lights shall be LED with “RGB” control.

9. Each area will be locally switched and designed for multi-level controls. Each classroom, office space and toilet rooms will have an occupancy sensor to turn lights off when unoccupied. Daylight sensors will be installed in each room where natural light is available for dimming of light fixtures.

10. The entire school will be controlled with an automatic lighting control system using the DDC control system for schedule programming of lights.

C. Emergency Lighting System:

1. An exterior 350 kw natural gas fuelled indoor emergency generator with sound attenuated housing will be provided. Light fixtures and LED exit signs will be installed to serve all egress areas such as corridors, intervening spaces, toilets, stairs and exit discharge exterior doors. The administration area lighting will be connected to the emergency generator.

2. The generator will be sized to include life safety systems, boilers and circulating pumps, communications systems and kitchen refrigeration.

D. Site Lighting System

1. Fixtures for area lighting will be pole-mounted cut-off 'LED' luminaries in the parking and drop-off areas. The fixtures shall be per Town of Brookline standards. Pole heights will be below 20 ft. Fixtures for the underground parking shall be low profile, suspended `LED` fixtures. The exterior lighting will be connected to the automatic lighting control system for photocell on and timed off operation. The site lighting fixtures will be dark sky compliant. The illumination level is 0.5 foot candle minimum for parking areas in accordance with Illuminating Engineering Society.

2. Building perimeter fixtures will be wall mounted cut-off over exterior doors for exit discharge.

E. Wiring Devices:

1. Each classroom will have a minimum of (2) duplex receptacles per teaching wall and (2) double duplex receptacles on dedicated circuits at classroom computer workstations. The teacher's workstation will have a double duplex receptacle also on a dedicated circuit. Refer to drawings.

2. Office areas will generally have (1) duplex outlet per wall. At each workstation a double duplex receptacle will be provided.

3. Corridors will have a cleaning receptacle at approximately 25 foot intervals.

4. Exterior weatherproof receptacles will be installed at exterior doors.

5. A system of computer grade panelboards with double neutrals and transient voltage surge suppressors will be provided for receptacle circuits.

F. Fire Alarm System:

1. A fire alarm and detection system will be provided with 60 battery back-up. The system will be of the addressable type where each device will be identified at the control panel and remote annunciator by device type and location to facilitate search for origin of alarms.

2. Smoke detectors will be provided in open areas, corridors, stairwells and other egress ways.

3. The sprinkler system will be supervised for water flow and tampering with valves.

4. Speaker/strobes will be provided in egress ways, classrooms, assembly spaces, open areas and other large spaces. Strobe only units will be provided in single toilets and conference rooms.

5. Manual pull stations will be provided at exit discharge doors.

6. The system will be remotely connected to automatically report alarms to fire department via an approved method by the fire department.

G. Uninterruptible Power Supply (UPS):

1. Two (2) 30kw, three (3) phase centralized UPS systems will be provided with battery back-up.

2. The system will provide conditioned power to sensitive electronic loads, telecommunication systems, bridge over power interruptions of short duration and allow an orderly shutdown of servers, communication systems, etc. during a prolonged power outage.

3. The UPS systems will also be connected to the stand by generator.

H. Lightning Protection System:

1. A system of lightning protection devices will be provided.

2. The lightning protection equipment will include air terminals, conductors, conduits, fasteners, connectors, ground rods, etc.

5. TESTING REQUIREMENTS

The Electrical Contractor shall provide testing of the following systems with the Owner and Owner's representative present:

- Lighting and power panels for correct phase balance.
- Emergency generator.
- Lighting control system (interior and exterior).
- Fire alarm system.
- Security system.
- Lightning protection system.

Testing reports shall be submitted to the engineer for review and approval before providing to the Owner.

6. OPERATION MANUALS AND MAINTENANCE MANUALS:

When the project is completed, the Electrical Contractor shall provide operation and maintenance manuals to the Owner.

7. RECORD DRAWINGS AND CONTROL DOCUMENTS:

When the project is completed, an as-built set of drawings, showing all lighting and power requirements from contract and addendum items, will be provided to the Owner.

8. COMMISSIONING

The project shall be commissioned per Section 018000 of the specifications.

9. RENEWABLE ENERGY PROVISIONS

Provisions for a renewable energy system will consist of a grid connected photovoltaic PV system intended to reduce the facilities demand for electricity. The photovoltaic system will be provided under a separate contract.

10. SITE UTILITIES

The Electric, Telephone and Cable TV utilities will be underground for each system provided.

11. CCTV

A Closed Circuit TV system will consist of computer servers with image software, computer monitors and IP based closed circuit TV cameras. The head end server will be located in the head end (MDF) room and will be rack mounted. The system can be accessed from any PC within the facility or externally via an IP address. Each camera can be viewed independently. The network video recorders (SAN) will record all cameras and store this information for 45 days at 30 images per second (virtual real time).

The location of the cameras is generally in corridors and exterior building perimeter. The exterior cameras are pan-tilt-zoom type.

The system will fully integrate with the access control system to allow viewing of events from a single alarm viewer. Camera images and recorded video will be linked to the access system to allow retrieval of video that is associated with an event.

12. INTRUSION SYSTEM

An intrusion system will consists of security panel, keypads, motion detectors and door contacts. The system is addressable which means that each device will be identified when an alarm occurs. The system is designed so that each perimeter classroom with grade access will have dual tech sensors along the exterior wall and corridors, door contacts at each exterior door.

The system can be partitioned into several zones. Therefore, it is possible to use the Gym area while the remainder of the school remains alarmed.

The system will include a digital transmitter to summons the local police department in the event of an alarm condition

The intrusion system will be connected to the automated lighting control system to automatically turn on lighting upon an alarm.

13. CARD ACCESS

A card access system includes a card access controller, door controllers and proximity readers/keypads. Proximity readers will be located at various locations. Each proximity reader will have a distinctive code to identify the user and a log will be kept in memory. The log within the panel can be accessed through a computer.

The alarm condition will also initiate real time recording on the integrated CCTV System. The system may be programmed with graphic maps allowing the end-user to quickly identify alarm conditions and lock/unlock doors.

The system is modular and may be easily expanded to accommodate any additional devices.

14. PHASING

The existing building shall be made safe for demolition by General Contractor.

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47924/Page 1/May 15, 2015

PLUMBING SYSTEMS NARRATIVE REPORT

OPTIONS 3B & 3D - NEW CONSTRUCTION

The following is the Plumbing system narrative, which defines the scope of work and capacities of the Plumbing system as well as the Basis of Design. The Plumbing Systems shall be designed and constructed for ***LEED for Schools*** where indicated on this narrative.

1. CODES

   A. All work installed under Section 220000 shall comply with the NH Building Code, MA Plumbing Code and all state, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT

   A. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Plumbing work and all items incidental thereto, including commissioning and testing.

3. GENERAL

   A. The Plumbing Systems that will serve the project are cold water, hot water, tempered water, sanitary waste and vent system, grease waste system, special waste system, storm drain system, natural gas and compressed air.

   B. The Building will be serviced by Municipal water and Municipal sewer system.

   C. All Plumbing in the building will conform to Accessibility Codes and to Water Conserving sections of the Plumbing Code.

4. DRAINAGE SYSTEM

   A. Soil, Waste, and Vent piping system is provided to connect to all fixtures and equipment. System runs from 10 feet outside building and terminates with stack vents through the roof.

   B. A separate Grease Waste System starting with connection to an exterior concrete grease interceptor running thru the kitchen and servery area fixtures and terminating with a vent terminal through the roof. Point of use grease interceptors are to be provided at designated kitchen fixtures. The grease interceptor is provided under Division 33 scope.

   C. Storm Drainage system is provided to drain all roofs with roof drains piped through the building to a point 10 feet outside the building.

   D. Drainage system piping will be service weight cast iron piping; hub and spigot with gaskets for below grade; no hub with gaskets, bands and damps for above grade 2 in. and larger. Waste and vent piping 1-1/2 in. and smaller will be type ‘L’ copper.

E. A separate Special Waste System shall be provided starting with a connection to an interior limestone chip acid neutralizer, running thru the building to collect science classroom fixtures and terminating with vent terminals through the roof. Special Waste and Vent piping will be Schedule 40 electric heat fused polypropylene piping, fittings and traps, flame retardant above grade and non-flame retardant below ground.

5. WATER SYSTEM

A. New 6 inch domestic water service from the municipal water system will be provided. A meter and backflow preventer, if required, will be provided.

B. Cold water distribution main is provided. Non-freeze wall hydrants with integral back flow preventers are provided along the exterior of the building.

C. Domestic hot water heating will be provided with a combination of gas fired, high efficiency, and condensing water heaters with separate storage tank. System is to be equipped with thermostatically controlled mixing devices to control water temperature to the fixtures.

D. A pump will re-circulate hot water from the piping system. Water temperature will be 120 deg. to serve general use fixtures. A 140 deg. F hot water will be supplied to the kitchen dishwasher.

E. Water piping will be type 'L' copper with wrot copper sweat fittings, silver solder or press-fit system. All piping will be insulated with 1 in. thick high density fiberglass.

6. GAS SYSTEM

A. Natural gas service will be provided for the building and will serve the boilers, domestic water heaters, kitchen cooking equipment, roof top equipment and generator.

B. Gas piping will be Schedule 40 black steel pipe with threaded gas pattern malleable fittings for 2 in. and under and butt welded fittings for 2-1/2 in. and larger.

7. COMPRESSED AIR SYSTEM

A. Compressed air will be provided for the vocational shop areas.

B. Compressed air piping will be Schedule 40 black steel pipe with threaded gas pattern malleable fittings.

8. FIXTURES ***LEED for Schools Credit WEp1 & WEc3***

A. Furnish and install all fixtures, including supports, connections, fittings, and any incidentals to make a complete installation.

B. Fixtures shall be the manufacturer's guaranteed label trademark indicating first quality. All acid resisting enameled ware shall bear the manufacturer's symbol signifying acid resisting material.

C. Vitreous china and acid resisting enameled fixtures, including stops, supplies and traps shall be of one manufacturer by Kohler, American Standard, or Eljer, or equal. Supports shall be Zurn, Smith, Josam, or equal. All fixtures shall be white. Faucets shall be Speakman, Chicago, or equal.

D. Fixtures shall be as scheduled on drawings.

1. Water Closet: High efficiency toilet, 1.28 gallon per flush, wall hung, vitreous china, siphon jet. Manually operated 1.28 gallon per flush-flush valve.

2. Urinal: High efficiency 0.13 gallon per flush urinal, wall hung, vitreous china. Manually operated 0.13 gallon per flush-flush valve.

3. Lavatory: Wall hung/countertop ADA lavatory with 0.5 GPM metering mixing faucet programmed for 10 second run-time cycle.

4. Sink: Elkay ADA stainless steel countertop sink with Chicago 201A faucet and 0.5 GPM aerator.

5. Drinking Fountain: Halsey Taylor hi-low wall mounted electric water cooler, stainless steel basin with bottle filling stations.

6. Janitor Sink: 24 x 24 x 10 Terrazo mop receptor Stern-Williams or equal.

7. Laboratory Sinks: Faucets with vacuum breakers and 0.74 GPM aerators.

9. DRAINS

A. Drains are cast iron, caulked outlets, nickaloy strainers, and in waterproofed areas and roofs shall have galvanized iron clamping rings with 6 lb. lead flashings to bond 9 in. in all directions. Drains shall be Smith, Zurn, Josam, or equal.

10. VALVES

A. Locate all valves so as to isolate all parts of the system. Shutoff valves 3 in. and smaller shall be ball valves, solder end or screwed, Apollo, or equal.

11. INSULATION

A. All water piping shall be insulated with snap-on fiberglass insulation Type ASJ-SSL, equal to Johns Manville Micro-Lok HP.

12. CLEANOUTS

A. Cleanouts shall be full size up to 4 in. threaded bronze plugs located as indicated on the drawings and/or where required in soil and waste pipes.

B. Cleanouts for Special Waste System shall be Zurn #Z9A-C04 polypropylene cleanout plug with Zurn #ZANB-1463-VP nickel bronze scoriated floor access cover.

13. ACCESS DOORS

A. Furnish access doors for access to all concealed parts of the plumbing system that require accessibility. Coordinate types and locations with the Architect.

14. WATER HEATER

A. Gas fired, high efficiency, condensing water heaters with separate storage tank.

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47920/Page 1/May 15, 2015

FIRE PROTECTION SYSTEMS NARRATIVE REPORT

OPTIONS 3B & 3D - NEW CONSTRUCTION

The following is the Fire Protection system narrative, which defines the scope of work and capacities of the Fire Protection system as well as the Basis of Design.

1. CODES

   A. All work installed under Section 210000 shall comply with the NH Building Code and all state, county, and federal codes, laws, statutes, and authorities having jurisdiction.

2. DESIGN INTENT

   A. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Fire Protection work and all items incidental thereto, including commissioning and testing.

3. DESCRIPTION

   A. The new building will be served by a new 8 inch fire service, double check valve assembly, wet alarm valve complete with electric bell, and fire department connection meeting local thread standards.

   B. System will be a combined standpipe/sprinkler system with control valve assemblies to limit the sprinkler area controlled to less than 52,000 s.f. as required by NFPA 13-2013.

   C. Control valve assemblies shall consist of a supervised shutoff valve, check valve, flow switch and test connection with drain. Standpipes meeting the requirements of NFPA 14-2013 shall be provided in the egress stairwells and in the Stage area.

   D. All areas of the building, including all finished and unfinished spaces, combustible concealed spaces, all electrical rooms and closets will be sprinklered.

   E. All sprinkler heads will be quick response, pendent in hung ceiling areas and upright in unfinished areas.

   F. Fire department valves and cabinets will be provided on each side of the Stage in the Building.

4. BASIS OF DESIGN

   A. The mechanical rooms, kitchen, science classrooms, and storage rooms are considered Ordinary Hazard Group 1; stage and vocational shops considered Ordinary Hazard Group 2; all other areas are considered light hazard.

   B. Required Design Densities:

Light Hazard Areas	0.10 GPM over 1,500 s.f.
Ordinary Hazard Group 1	0.15 GPM over 1,500 s.f.
Ordinary Hazard Group 2	0.20 GPM over 1,500 s.f.

C. Sprinkler spacing (max.):

Light Hazard Areas:	225 s.f.
Ordinary Hazard Areas:	130 s.f.

D. A flow test will be required to be performed to confirm the Municipal water supply.

5. PIPING

A. Sprinkler piping 1-1/2 in. and smaller shall be ASTM A-53, Schedule 40 black steel pipe. Sprinkler/standpipe piping 2 in. and larger shall be ASTM A-135, Schedule 10 black steel pipe.

6. FITTINGS

A. Fittings on fire service piping, 2 in. and larger, shall be Victaulic Fire Lock Ductile Iron Fittings conforming to ASTM A-536 with integral grooved shoulder and back stop lugs and grooved ends for use with Style 009-EZ or Style 005 couplings. Branch line fittings shall be welded or shall be Victaulic 920/920N Mechanical Tees. Schedule 10 pipe shall be roll grooved. Schedule 40 pipe, where used with mechanical couplings, shall be roll grooved and shall be threaded where used with screwed fittings. Fittings for threaded piping shall be malleable iron screwed sprinkler fittings.

7. JOINTS

A. Threaded pipe joints shall have an approved thread compound applied on male threads only. Teflon tape shall be used for threads on sprinkler heads. Joints on piping, 2 in. and larger, shall be made up with Victaulic, or equal, Fire Lock Style 005, rigid coupling of ductile iron and pressure responsive gasket system for wet sprinkler system as recommended by manufacturer.

8. DOUBLE CHECK VALVE ASSEMBLY

A. Double check valve assembly shall be New Hampshire State approved, U.L./F.M. approved, with iron body bronze mounted construction complete with supervised OS & Y gate valves and test cocks. Furnish two spare sets of gaskets and repair kits.

B. Double check valve detector assembly shall be of one of the following:

1. Watts Series 757-OSY
2. Wilkins 350A-OSY
3. Conbraco Series 4S-100
4. Or equal

Dover High School and Career Technical Center
Dover, NH
J#831 044 00.00
L#47909/Page 1/May 15, 2015

TECHNOLOGY SYSTEMS NARRATIVE REPORT

OPTIONS 3B & 3D - NEW CONSTRUCTION

The following is the Technology System narrative, which defines the scope of work and capacities of the Communications system infrastructure and Security system as well as the Basis of Design.

1. CODES

   A. All work installed under Section 270000 shall comply with the New Hampshire Building Code, IBC 2009, and all local, county, and federal codes, laws, statues, and authorities having jurisdiction.

2. DESIGN INTENT

   A. All work is new and consists of furnishing all materials, equipment, labor, transportation, facilities, and all operations and adjustments required for the complete and operating installation of the Technology and Security work and all items incidental thereto, including commissioning and testing.

3. TECHNOLOGY

   A. The data system infrastructure will consist of fiber optic backbone cabling horizontal wiring will consist of Category 6A UTP Plenum rated cabling for both data and telephone systems for gigabit connectivity. The telephone infrastructure will accommodate PBX, or VOIP based voice systems. A new IP telephone system will be used.

   B. Each classroom will have 4 data outlets for student computers. Two data, one voice with video and audio connections to a wall-mounted interactive projector or touchscreen will be provided at teacher's station with interconnectivity to a interactive whiteboard. A wall phone outlet with 2 way ceiling speaker will be provided for communications with administration. Wireless access points will be provided in all classrooms and other spaces in addition to (2) CAT6A.cables to access points multimode fiber will also be provided.

   C. A central paging system will be provided and integrated with the telephone system. The paging speakers will be IP.

   D. A wireless GPS/LAN based master clock system will be provided with 120V wireless remote clocks that act as transceivers.

   E. The Main Distribution Frame (MDF) will contain all core network switching and IP voice switch. Intermediate Distribution Frames (IDFs) will serve each floor/wing of the school. A fiber optic backbone will be provided from each IDF to MDF. The backbone will be designed for 10 Gbps Ethernet.

4. TESTING REQUIREMENTS

A. The Technology and Security Contractors shall provide testing of the following systems with the Owner and Owner's representative present:

- Telephone and data cabling
- Fiber optic backbone cabling
- Paging system
- Wireless clock system
- A/V wiring for classrooms

Testing reports shall be submitted to the engineer for review and approval before providing to the Owner.

5. OPERATION MANUALS AND MAINTENANCE MANUALS:

A. When the project is completed, the Technology Contractor shall provide operation and maintenance manuals to the Owner.

6. RECORD DRAWINGS AND CONTROL DOCUMENTS:

A. When the project is completed, an as-built set of drawings, showing all lighting and power requirements from contract and addendum items, will be provided to the Owner.

7. COMMISSIONING

A. The project shall be commissioned per Commissioning Section of the specifications.

8. PHASING

A. The existing telephone, internet and cable-TV services will not be impacted by phasing.

Appendix A.5

Structural Cost Estimating Narratives

Dover Regional High School and Career Technical Center

Dover, NH

Options Summary for Pricing – Description of Structural Systems

Three conceptual options are described herein, as follows:

Option1 - Renovation Addition: This scheme involves demolishing the existing three-story classroom wing, the CTE addition and the World Languages wing, but maintaining and renovating the existing gymnasium, auditorium, music room and related westerly areas of the existing school. New academic and technical education spaces would be constructed on the northwest side of the existing auditorium/gymnasium. The footprint of this new addition would occupy portions of the existing parking lot, the softball field and the tennis courts. The new addition is envisioned as a three-story building, connected directly to the renovated existing auditorium/gymnasium. The new addition would be approximately 228,000 gross square feet, while the renovated floor area of the 1967 auditorium/gym wing would total approximately 66,000 square feet.

Option 2 – New Construction: This scheme involves demolition of the entire existing school and construction of an all-new three-story high school, sited on the land now occupied by the softball field and the tennis courts and fronting on Alumni Drive. The new school would encompass all of the academic and CTC functions of the existing school. Total floor area for the new school is estimated at 300,000 to 320,000 square feet.

The new building components described for Options 1 and 2 above would be of similar construction, except that Option 2 is larger due to replacement of the auditorium and gymnasium. Option 2 may be sited slightly farther to the northwest in order isolate construction activities from the existing high school and to avoid unfavorable soil conditions found in the parking lot area immediately adjacent to the existing school.

Option 3 – Base Rehabilitation: This option involves renovation of the existing school, including replacement of mechanical, electrical, plumbing and fire protection systems, all interior finishes, windows, and the Kalwal exterior wall systems of the three-story classroom wing. Existing corridor and classroom partitioning will be largely maintained. Structurally, this scheme will involve retrofit of the three story classroom wing steel frame to introduce a lateral load bracing system, providing a defined load path for wind and seismic loads. A further description of this bracing system is provided below. Other structural modifications to the existing school associated with this option are expected to be minor.

Since the High School must remain in continuous operation, Option 3 would be completed in several phases, extending over as many as six years. Facilitating this phased construction requires “swing space” be available for relocation of various programs in the course of the project. Initially, this will involve construction of a new 20,000 square foot free-standing building as a permanent home for three relocated CTE programs (Auto Technology, Auto Collision and Building Technology). Academic classroom swing space would be provided either by bringing modular classrooms on site, or by renovation of the nearby McIntosh College building to provide 12 classrooms and administrative spaces at that facility.

Included in all three Options is an expansion of the existing Animal Sciences barn, which is described at the end of this document.

Further detail on the structural systems to be utilized for each option is provided below.

Option 1 - Renovation Addition

The new addition would be structurally independent of the existing auditorium/gym and the two buildings would be separated by a seismic isolation joint.

Building Superstructure: Structural steel, concentrically braced frame.

Roof Areas: 1.5" deep cold-formed steel deck supported on open web steel joists spaced at 5'-0" on centers, with the joists bearing on the primary structural steel frame. Classroom and academic areas will utilize "K" series open web joists. High bay tech education and assembly areas ("Town Square", for example) will utilize LH series roof joists.

Framed Floors: Cast-in-place normal weight concrete slabs on 2" deep, cold-formed composite steel deck. Total slab thickness 5.50" nominal. Composite structural steel beams and girders utilizing headed shear studs field welded through the steel deck to the top flanges of the steel sections.

Columns and lateral bracing: Square HSS structural steel sections.

Lowest level floor slabs (areas with spread footing foundations): 4" thick, normal weight concrete slabs, grade supported, with welded wire fabric reinforcing. Slabs will be cast over a vapor barrier and 8" compacted gravel base course.

Lowest level floor slabs (pile supported foundation areas): 10" thick, reinforced concrete framed slab spanning between grade beams.

Exterior wall construction: 4" brick veneer cavity wall with 6" cold-formed steel stud backup.

Foundations: The borings completed to date indicate variable subsurface conditions that include loose granular fills, loose alluvial deposits and marine clay deposits beneath the footprint of the proposed addition. Foundations and site preparation requirements are expected to vary throughout the footprint of the building addition, as follows:

- Area immediately adjacent to the existing auditorium/gym, within the limits of the existing parking lot: pile supported foundation consisting of HP10 driven steel piles and cast-in-place concrete pile caps and grade beams. The piles will be end bearing on dense glacial till (or ledge) at depths of up to 30 feet.
- Area northwest of the parking lot, along Alumni drive (now partially occupied by the southerly portions of the softball field and tennis courts): Shallow foundations (4' frost depth) consisting of cast-in-place concrete spread and strip footings, bearing on glacial till or bedrock. Design bearing pressure: 2 tons/square foot.
- Area northwest of the parking lot, away from Alumni drive (now partially occupied by the northerly portions of the softball field and tennis courts): Shallow foundations consisting of cast-in-place concrete spread and strip footings bearing on native alluvial soils augmented by ground improvements. Design bearing pressure: 2 tons/square foot. Ground improvements in this area will be comprised of Aggregate Piers installed to depths of 15 to 20 feet beneath the bottom of footing elevations and on an 8' x 8' grid beneath the ground floor slab.

The portion of the building that will be supported on piles will be separated from the rest of the new construction by an expansion joint, as a precaution against differential settlement resulting from dissimilar foundations.

Option 2 - New Construction

The proposed structural systems for the New Construction option are similar to those proposed above for Option 1. For this option, FBRA anticipates that the new building would be sited further northwest, thereby seeking to avoid the low bearing capacity soils found in the parking lot adjacent to the existing building.

Building Superstructure: Structural steel, concentrically braced frame.

Roof Areas: 1.5" deep cold-formed steel deck supported on open web steel joists spaced at 5'-0" on centers, with the joists bearing on the primary structural steel frame. Classroom and academic areas will utilize "K" series open web joists. High bay tech education and assembly areas ("Town Square", for example) will utilize LH series roof joists.

Auditorium roof structure: Fabricated structural steel trusses at 12'-0" on centers with W10 infill roof beams between trusses.

Gymnasium roof structure: DLH series open web steel joists at 5'-0" on centers, 1.5" deep cold-formed acoustic roof deck.

Framed Floors: Cast-in-place normal weight concrete slabs on 2" deep, cold-formed, composite steel deck. Total slab thickness: 5.50" nominal. Composite structural steel beams and girders utilizing headed shear studs field welded through the steel deck to the top flanges of the steel sections.

Columns and lateral bracing: Square HSS structural steel sections (ASTM A500).

Lowest-level Slabs: 4" normal weight concrete slabs, grade supported, with welded wire fabric reinforcing. Slabs will be cast over a vapor barrier and 8" compacted gravel base course.

Exterior wall construction: 4" brick veneer cavity wall with 6" cold-formed steel stud backup.

Foundations: The borings completed to date indicate variable subsurface conditions beneath the footprint of the proposed site.

- Area northwest of the parking lot, along Alumni drive (now partially occupied by the southerly portions of the softball field and tennis courts): Shallow foundations (4' frost depth) consisting of cast-in-place concrete spread and strip footings, bearing on glacial till or bedrock. Design bearing pressure: 2 tons/square foot.
- Area northwest of the parking lot, away from Alumni drive (now partially occupied by the northerly portions of the softball field and tennis courts): Shallow foundations consisting of cast-in-place concrete spread and strip footings bearing on native alluvial soils augmented by ground improvements. Design bearing pressure: 2 tons/square foot. Ground improvements in this area will be comprised of Aggregate Piers installed to depths of 15 to 20 feet beneath the bottom of footing elevations and on an 8' x 8' grid beneath the ground floor slab.

Option 3 – Base Renovation

This Option involves the following components:

- Renovations to the existing school, including the introduction of a lateral load-resisting system into the three-story, 1967 classroom wing.
- Construction of a new 20,000 square foot CTE shop building to house Automotive Technology and Electronics spaces.
- (Optional) Upgrades to the existing McIntosh College building as needed to occupy that building for "swing space" during the phased reconstruction of the High School.
- Expansion of the existing Animal Sciences barn (see below).

Option 3 would involve wholesale replacement of existing MEP systems as well as replacement of architectural floor, wall and ceiling finishes throughout the school. The existing corridor and interior partitioning layout would be maintained.

The building structure and interior partitioning in the auditorium/gymnasium area is expected to remain unchanged.

For the three-story classroom wing, structural work is expected to involve replacement of the existing Kalwal window/façade systems and upgrades related to installation of lateral load-resisting bracing systems.

Due to the load capacity limitations of the existing building, it is anticipated that the existing Kalwal/window systems in the 1967 classroom wing will be replaced with new, similar systems of similar weight.

As it exists, the 1967 classroom wing lacks has no defined structural systems intended by design to resist lateral loads (wind and seismic loads). Renovation of this wing will involve introduction of a lateral bracing system consisting of concentrically braced bay, forming vertical trusses extending from the foundation to the roof. The following work will be required to implement this plan:

- Introduction of approximately eight (8), three-story vertical bracing bays involving approximately twelve existing column locations. The diagonal bracing at each floor level will be new HSS structural steel elements, typically installed between the existing columns and floor framing.
- Installation of the diagonal braces noted above will require welded gusset plates at the associated beam-to column connections where new braces are added.
- It is anticipated that minor structural reinforcement of floor and roof framing members will be required in the bays where bracing is added.
- The bracing systems will impose additional vertical loads on the existing building columns and foundations. It is anticipated that structural reinforcement of the existing columns will be required in all bays where lateral bracing systems are added. The existing columns are square and rectangular HSS shapes, some with existing supplemental plate reinforcement, typically with a gypsum fireproofing enclosure and a sheet metal outer shell. Reinforcing these columns in the braced bays will require full height removal of the outer shell and gypsum fireproofing. Column upgrades will involve welding on full height plates or channels to the existing HSS columns.
- Columns in the bracing bays will also require augmentation of the base plates and anchor bolts.

- Foundations that will support columns that are elements in the new bracing systems will also have to be upgraded for the additional imposed loads. This work will involve temporary shoring of the building and demolition and replacement of existing pile caps and grade beams.
- Foundation capacity for the columns involved in the new lateral bracing system will be augmented by installation of supplemental piles. Due to overhead space constraints that result from working within the existing building, the supplemental piles are expected to be either helical augured piles or drilled mini-piles.
- Renovation of the building and construction of the new lateral bracing system will be phased over several years, generally progressing from the foundation upward to the roof.

Review of the existing auditorium/gymnasium wing indicates that lateral system upgrades in this area are not necessary or recommened. The number and arrangement of the existing load-bearing masonry walls in this area provide an inherent and adequate means of resisting wind and seismic loads.

The existing bus drop-off canopy, comprised of precast concrete hemispherical elements and columns, is expected to be demolished and replaced as part of the Option 3 renovation.

Both of the later additions to the school (i.e., the existing 1989 CTE building and the 2002 "World Languages" Wing) were originally designed for specific lateral loading criteria. Renovations in both areas are expected to be limited to MEP systems and architectural finishes. Structural upgrades in these areas are not anticipated.

The proposed new one-story CTE shop building will house automotive and electrical trade training spaces. This building is envisioned as being one story, with a footprint area of 20,000 gross square feet. The building will be sited northwest of the existing gymnasium. Roof construction will be comprised of 1.5" cold-formed steel deck on LH series open web steel joists, with the joists supported on load-bearing 10" thick concrete masonry walls. Exterior walls would have a 4" brick veneer. The building would have a pile foundation comprised of HP10 steel piles, reinforced concrete pile caps and grade beams, and a 10" reinforced concrete framed floor slab.

Animal Sciences Barn

All three Options above include expansion of the existing Animal Sciences barn. The existing barn is approximately 2000 square feet, the proposed addition will add approximately 6000 square feet. The barn addition will be of wood construction, using dimensional lumber framing and perimeter concrete foundation frost walls and strip footings.

End of Structural Systems Narrative

Appendix A.6

Civil Cost Estimating Narratives

BASE REHABILITATION OPTION

Summary

A new 20,000 sf CTC building will be constructed on the west side of the existing school. The building will be located in the area that is currently a ball infield, just beyond the existing parking area. There will also be renovation of and an addition to the existing Animal Science building north of the main school building.

Access/Circulation

Points of access to the school will be preserved on Bellamy Road and Durham Road via Alumni Drive. Minor changes to the existing on-site circulation patterns will be required, but are limited to: construction of temporary walkways for access to the modular classrooms, construction of pedestrian walkways for access to the new CTC building, and reconfiguration of the parking and pedestrian access adjacent to the Animal Science building.

Parking

The building addition at the Animal Science area will require reconfiguration of the adjacent parking areas. The addition encroaches on the existing parking in the small dedicated lot west of the existing building, as well as on the existing parking south of the building. A total of 21 parking spaces will be disrupted and will need to be replaced – possibly by expansion of the dedicated lot and realignment of access thereto.

A December 2014 visual inspection of the existing parking configuration and pavement conditions resulted in the following recommendations:

> At A Lot, B Lot, C Lot, and 1989 Addition, perform full depth pavement reconstruction, including new pavement and gravels. Install heavy duty pavement section for truck travel paths in Lot C. (Addition of geogrid may be necessary pending results of a geotechnical investigation.) Replace/install bituminous concrete curb at A Lot, B Lot, and C Lot. Replace bituminous asphalt sidewalks at A Lot, B Lot, C Lot, and 1989 Addition, including walks along Alumni Drive.
>
> At the Senior Lot, grind the pavement and place a 1" pavement overlay. Replace the bituminous asphalt sidewalk along Alumni Drive.
>
> All ADA requirements will need to be complied with including designating the required number of spaces with proper signage, striping, accessible routes, handrails, landings at doorways, etc. Specific requirements at each of the parking areas and details of modifications will be further defined during the design phase.

Building Entrances

The new CTC building, Animal Science building addition, and renovated area of the existing Animal Science building will be fully ADA accessible. Routes will be equipped with ramps, signage, and pavement markings as appropriate.

Grades

The area of the new CTC building and the modular classrooms is currently fairly level since it is a ball field. Minimal grading will be required in this area to achieve appropriate reveal and promote positive drainage away from the new building. Some minor grading will also be required to construct temporary and

permanent pedestrian walkways. Minimal grading will also be required around the addition to the Animal Science building to achieve appropriate reveal and promote positive drainage.

Utilities

Construction of the new CTC building will require removal of at least a portion of the underdrain at the existing ball field.

Stormwater runoff from new impervious surfaces (buildings, walkways, paved parking areas) will need to be detained and treated in accordance with City and State requirements. It is assumed that the existing closed drainage system on the site will be adequate for collection of the stormwater runoff, however, excavation may be required to install subsurface structures for control and/or treatment of runoff.

Sewer, water, electric, telecom, and natural gas will be reconfigured/extended as necessary to service the new CTC building and the Animal Science building addition. Temporary connections will be provided for the modular classrooms.

RENO ADD OPTION 2B

Summary

The building addition will be constructed on the west side of the existing school and will require reconfiguration of portions of the athletic fields, as well as the majority of the parking areas and access drives. The ball field, four tennis courts, and parking area currently in the area of the proposed building addition will be relocated to the east side of the school. A new parking area will be constructed in the area of the existing building once demolition of the structure is complete.

Access/Circulation

Points of access to the school will be preserved on Bellamy Road and Durham Road via Alumni Drive. A bus loop will be provided at the main entrance on the east side of the building. There will also be a shorter bus drop-off on the southwest side of the building at the main entrance to the CTC, sufficient to accommodate a single bus. Access to the Animal Science buildings will be as in the current conditions. A new driveway will be provided off Alumni Drive to provide access around the west side of the building to the kitchen on the north side – possibly connecting through to the parking area at the Animal Science buildings. As shown on the plan (no connection), deliveries to the kitchen will require the WB-50 delivery vehicle to drive beyond the kitchen doorway, back up 90-degrees to the loading area, and then turn 90-degrees forward to exit to the west. If connection to the Animal Science building parking area is made, the delivery vehicle will be able to exit to the east, but relocation of the existing dumpster enclosure will be necessary. All sides of the building will be accessible by fire truck. All parking and access will be paved and the majority of these areas will have curbing. Traffic circulation throughout the site (one-way vs two-way) as well as queuing requirements for bus traffic will be evaluated during the design phase.

Parking

The reconfiguration of the athletic fields and driveways associated with the building addition construction eliminates a total of 444 existing parking spaces on the site. New parking areas are proposed in order to maintain the existing 444 parking spaces available. The majority of the new parking is provided in two large lots on the east side of the building. The parking lot closest to the main building entrance contains 145 spaces, including six ADA accessible (one van-accessible). The second lot is situated adjacent to the relocated athletic fields and contains 120 parking spaces, including a single ADA van-accessible space. At the new Animal Science Building, parking has been reconfigured to provide 77 spaces, including two ADA accessible (one van-accessible). At the southwest side of the building, 31 spaces dedicated to the CTC are provided along the bus drop-off area near the entrance. This parking area includes two ADA accessible (one van-accessible) spaces. There is a new 23-space parking area along the south side of the relocated ball field, as well as a 48-space parking area at the western end of Alumni Drive near the intersection with Bellamy Road. ADA parking is not shown in these areas, but can be added during the design phase if required. The existing ball field on the northwest corner of the site has a small 7-space dedicated parking area, which appears (based on aerial photography) to contain 3 ADA spaces. According to current ADA requirements, a total of 9 ADA accessible parking spaces are required for a parking area containing 444 spaces. However, if the parking area is subdivided into smaller lots, additional ADA accessible spaces are required. Details of the parking areas and allocation of dedicated parking will be defined during the design phase.

Building Entrances

The main entrance to the building is on the east side and is equipped with a bus loop/drop-off. Entrance to the CTC is on the southwest side of the building on Alumni Drive. There will be a delivery entrance for the Automotive Collision area from Alumni Drive. There will also be a delivery entrance for the Automotive Technology area and the Building Technology area on the northwest side of the new building. Delivery access is provided on the north side of the building at the kitchen entrance, with an area sufficient for turning movements of a WB-50 delivery vehicle. The area required for the delivery vehicle to maneuver will encroach on the lacrosse/ball field. The building addition and renovated areas of the existing building will be fully ADA accessible. Routes will be equipped with ramps, signage, and pavement markings as appropriate. ADA-accessible parking will be dispersed throughout new parking areas.

Grades

The finish floor of building renovation and addition will be at elevation 96.4 with storage on the floor below at elevation 81.4. Grades of the parking area at the Animal Science buildings are at the lower elevation and mimic existing topography. The new parking area and bus loop in the area of the former school building is at the higher elevation. Due to the close proximity of these areas, a retaining wall will be required. The wall will be constructed to be 13 feet high at the building, extending southeast and perpendicular to the building for 315 LF to meet grade. Stairs are proposed at the building for pedestrian connection between the upper and lower parking areas. The parking areas and access will be graded with slopes of approximately 1% to 3%. The outer extents of the driveway access and parking areas are primarily within the limits of the existing so there will be no further disturbance of wetlands. Some minor grading will be required adjacent to the new pavement, but will be restored to a vegetated state following completion of the construction.

Utilities

Construction of the building addition will require removal of the underdrain at existing ball field. A new underdrain system may be required for the relocated ball field. The underdrain system at the lacrosse field near the kitchen service/delivery entrance may be impacted by construction of the vehicle access area.

Stormwater is collected in a closed drainage system in the existing parking area on the east side of the building. This system will need to be reconfigured and tied into a new closed drainage system in the new parking areas and driveways. Detention and treatment of stormwater will be provided in accordance with City and State requirements.

Sewer, water, electric, telecom, and natural gas will be reconfigured/extended as necessary to service the new building.

NEW CONSTRUCTION OPTION 3

Summary

The new school building will be constructed on the west side of the former school and will require reconfiguration of portions of the athletic fields, as well as the majority of the parking areas and access drives. The ball field, four tennis courts, and parking area currently in the area of the proposed building will be relocated to the east side of the school. Two additional tennis courts are also proposed, along with a new soccer field, overlapping the ball field. New parking areas will be constructed in the area of the existing building once demolition of the structure is complete.

Access/Circulation

Points of access to the school will be preserved on Bellamy Road and Durham Road via Alumni Drive. A bus loop will be provided at the main entrance on the east side of the building. Access to the Animal Science buildings will be as in the current conditions. A new driveway will be provided off Alumni Drive for access to the west side of the building. Deliveries to the northeast corner of the new building will require a WB-50 delivery vehicle to drive partially around the bus loop, back up 90-degrees to the loading area, and then pull forward, turning 90-degrees to continue around the bus loop and exit to the southwest. All parking and access will be paved and the majority of these areas will have curbing. Traffic circulation throughout the site (one-way vs two-way) as well as queuing requirements for bus traffic will be evaluated during the design phase.

Parking

The reconfiguration of the athletic fields and driveways associated with the building addition construction eliminates a total of 444 existing parking spaces on the site. New parking areas are proposed in order to maintain the existing 444 parking spaces available. As shown, the layout includes 455 parking spaces; however, this number will be reduced by the incorporation of ADA spaces. The majority of the new parking is provided in a large lot on the east side of the building, containing 313 spaces. At the new Animal Science Building, parking has been reconfigured to provide 77 spaces, including two ADA accessible (one van-accessible). At the southwest side of the building, 15 spaces are provided along Alumni Drive – possibly dedicated to the CTC. There is a new 50-space parking area at the western end of Alumni Drive near the intersection with Bellamy Road. ADA parking is not shown in most of these areas, but will be added during the design phase as required. According to current ADA requirements, a total of 9 ADA accessible parking spaces are required for a parking area containing 444 spaces. However, if the parking area is subdivided into smaller lots, additional ADA accessible spaces are required. Details of the parking areas and allocation of dedicated parking will be defined during the design phase.

Building Entrances

The main entrance to the building is on the east side and is equipped with a bus loop/drop-off. There will be delivery entrances for the Automotive Collision, the Automotive Technology, and the Building Technology areas on the northwest side of the new building from Alumni Drive. An area sufficient for turning movements of a WB-50 delivery vehicle is provided at the loading dock(s) at the northeast corner of the building. The new building will be fully ADA accessible. Routes will be equipped with

ramps, signage, and pavement markings as appropriate. ADA-accessible parking will be dispersed throughout new parking areas.

Grades

The finish floor of the new building will be at elevation 96.4 (approximately). Grades of the parking area at the Animal Science buildings (FFE=81.4+/-) are at a lower elevation and mimic existing topography. The parking area and bus loop for the new school building are at the higher elevation. Due to the close proximity of these areas and the difference in elevation, a retaining wall will be required. The wall will be constructed to be approximately 10 feet high at the bus loop, extending southeast along the lower parking area for approximately 405 LF to meet grade. Stairs are proposed for pedestrian connection between the new building and the lower parking area. The parking areas and access will be graded with slopes of approximately 1% to 3%. The athletic fields will be graded to recommended slopes, with steeper vegetated slopes as necessary between adjacent parking and driveways. The outer extents of the driveway access and parking areas are primarily within the limits of the existing so there will be no further disturbance of wetlands. Some minor grading will be required adjacent to the new pavement, but will be restored to a vegetated state following completion of the construction.

Utilities

Construction of the new building will require removal of the underdrain at existing ball field. A new underdrain system may be required for the relocated ball field. The underdrain system at the lacrosse field on the north side of the building may be impacted by the new construction.

Stormwater is currently collected in a closed drainage system in the existing parking area on the east side of the building. Since this area will be entirely reconfigured as new parking and athletic fields, a new closed drainage system will be required. Detention and treatment of stormwater will be provided in accordance with City and State requirements.

Sewer, water, electric, telecom, and natural gas will be reconfigured/extended as necessary to service the new building.